EVALUATION OF PHYSIOLOGICAL AND PSYCHOLOGICAL IMPAIRMENT OF HUMAN PERFORMANCE IN COLD STRESSED SUBJECTS

MIDTERM REPORT

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The data presented here deals with the physiological and psychological responses of man (13 subjects) to cold exposure (0°C) and added stresses. The additional stresses included cold water (15°C-mid thigh), sleep deprivation (24 hr) and exercise (70% maximum heart rate). Cardiovascular and respiratory parameters were monitored throughout the experiments. Urinary catecholamine excretion was determined to estimate stress levels. Skin and rectal temperatures were continuously monitored to evaluate temperature regulation. EMG monitoring was used to study the onset, pattern and magnitude of shivering in seven muscle groups. Four methods for short term shiver suppression were evaluated under the five experimental protocols. The CCAB was used to evaluate cognitive function and the F.A.T.S. system was employed to evaluate rifle shooting performance. Shooting performance and cognitive function were not significantly affected by additional stressors. Shivering onset was delayed with exercise and appeared to occur earlier with sleep deprivation. Onset of shivering was significantly correlated with rectal temperature and minute ventilation. Voluntary suppression of shiver was demonstrated with breath holding, relaxation and mental arithmetic.

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INTRODUCTION

Military personnel are frequently exposed to the environmental stress of cold water and/or cold air. In addition, most of them at these times will be required to perform a certain amount of exercise. During these situations, personnel are required to make decisions relative to previous orders and present conditions, and then execute them quickly and accurately. There is a paucity of information from a physiological and psychological perspective concerning performance under these conditions, however.

Shivering is one of the most common physiological reactions to cold stress. Its occurence is demoralizing to military personnel and greatly inhibits their smooth execution of various motor tasks. Shivering is an overt oscillation of the body in response to a cold stress and involves the synchronous discharge of various muscle groups. The major function of shiver is to increase heat production. This thermal generating reflex is associated with whole body tonic and clonic-like muscle activity thus impairing motor performance.

Because shivering is an oscillation it therefore can be studied from the point of view of (1) being the result of a "central oscillator" e.g. the posterior nucleus of the hypothalamus, which send signals to the periphery to cause overt body shakes, (2) a spinal reflex oscillator in which the segmental stretch reflexes have an increased gain and consequently cause the overt oscillation, or (3) a mechanical-reflex oscillator in which the mechanical properties of the periphery determine the frequency and amplitude of the oscillation. It is not easy to design experiments that clearly show a central oscillator or central pattern generator since this kind of generators might be fine tuned by phasic inputs from the periphery or in fact may be overidden by sensory input (Wyman, 1977).

If shivering is primarily the result of the activation of a neural-mechanical oscillator, then the addition of weight (for example a rifle) should have some effect on decreasing the amplitude of the shivering. On the other hand, if the shivering is initiated more by a central oscillator, then relaxation techniques in which the central shivering oscillator could be temporarily inhibited would be beneficial. Based upon our research to date, it seems that shivering has features that resemble a combination of

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both a peripheral as well as central oscillator. Addition of weights does cause a decrease in the shivering amplitude (peripheral oscillator) and certain subjects on demand can temporarily stop overt shivering by voluntary or conscious muscle relaxation (central oscillator) (Martin and Cooper, 1981).

Shiver is one of the body's few overall oscillations, although Uprus et al. (1935) notes that overt body tremors also occur during fever, relaxation of sphincters and emotional stresses such as fright. It should be noted that patients recovering from anesthesia also have an overt body shake or tremor (Sessler, et al., 1986). Shivering usually starts rapidly as early as two minutes after exposure to cold air and becomes generalized by 10-24 minutes (Stuart, et al., 1966b) with a consequent increase in oxygen consumption up to 3-4 times basal levels after fifteen minutes of cold exposure (Iampietro, et al., 1960).

Shivering is considered by some to be a natural amplification of physiological tremor. The similar frequency range of both tremors and mechanically loaded limbs (Hemingway, 1963) supports this theory. In addition, the studies of Sato (1976, 1983) indicate that cold peripheral temperatures increase the sensitivity of the stretch reflex. Due to the overt similarities of shivering to other oscillations, it has been compared to postural tremor (Schneider and Brooke, 1979), physiological tremor or Parkinsonian tremors (Stuart, et al., 1966a), and physiological action tremor or clonus (Pozos, et al., 1986). Although these studies have focused on similarities among various oscillations, there are enough questions concerning the methodologies employed in many of these experiments that a definite relationship between these other oscillations and shiver remains unclear.

Concerning the hypothesis that shivering is primarily an oscillation triggered by a central oscillator, it should be pointed out that shiver can be voluntarily stopped for short periods of time. Shivering can occur in decorticate (Aring, 1935) and thalamectomized animals (Clark, et al., 1939) and in animals with anterior hypothalmic lesions (Bazett, et al., 1933). Decerebrate animals, however, do not shiver. The primary motor center for shiver is located in the dorsomedial portion of the posterior hypothalamus (Stuart, et al., 1961; Hemingway, 1963). The preoptic area is inhibitory to the dorsomedial area of the hypothalmus. Once this inhibition is removed,

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the dorsal medial area of the hypothalmus is activated which then transmits signals bilaterally down the brainstem to the lateral columns of the spinal cord. These impulses are nonrhythmic and do not cause the actual muscle shaking but do increase the muscle metabolism as much as 50 percent even before shivering occurs (Stuart, et al., 1966b; Hemingway, 1963).

This brief review would be remiss if it did not mention the extensive studies that have been done by Simon (1974). Basically his studies support the view that the motorneuron pools in the spinal cord are responsible for most of the chararacteristic features of shivering although the hypothalamus also plays some role that is still not clearly defined (personal communciation between R. Pozos and Simon, 1985).

In summary, there have been studies dealing with shivering which indicate that the control of shivering as a complex oscillation involves more than likely multiple central oscillators which interact with peripheral input signals.

Reports on the attempts to influence the appearance of shivering have been infrequent. Blatteis (1960) reported that the onset of shivering in dogs was not dependent on afferent impulses returning from the cooled leg because nerve section before or during cooling did not affect its occurrence. The appearance of shivering seemed to be dependent on the cooled blood entering the truncal circulation since occluding the femoral vessels abolished shiver. Martin and Cooper (1981) reported that having shivering subjects perform mathematical calculations or isometric muscle contractions caused a decrease in shiver intensity. Their data suggested that secondary centers in the cerebral cortex could have a modulating influence on the shivering "centers". Mekjavic and Eiken (1985) have recently reported that shivering in human subjects could be inhibited as well by selectively warming facial areas. Following facial warming, they were able to show a decrease in the integrated electromyographic activity in the brachial biceps, trapezius and the femoral rectus muscles. This data suggests that the trigeminal nerve plays some role in terms of overall thermoregulatory responses. Their conclusions are somewhat at odds with those of Buguet, et al. (1976) who reported that counter current heat exchange between the jugular vein and the carotid artery was sufficient to cause cooling of the hypothalmus and initiate shivering. D'Anna (1967)

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reported that peripheral stimulation to the footpad of the dog would also inhibit shivering. Pozos (1980) reported that the inspiration of warm humiaified air decreased shiver. He postulated that the warm humidified air would stimulate receptors in the larynx, treachea and glottis which would influence shivering.

The above observation (Pozos, 1980) suggests a possible interaction between the ventilatory system and shivering (Lim, 1960; Pozos and Wittmers, 1983). Although it is commonly thought that certain components of the ventilatory cycle (inspiration or expiration) are synchronized with an increase or a decrease in the amplitude of shivering, this has not been seen with human subjects.

There have been no studies to date that investigate the possible augmenting effect of the combination of fatigue or sleep deprivation and exercise on the expression of shivering. Military personnel in the field are frequently stressed by cold air and cold water as well as by sleep deprivation and/or exercise, and are required to think clearly and have good motor control and weapons accuracy; studies of this sort are not only needed but essential for the safety of personnel and the successful completion of their missions.

The present study addresses shiver expression and voluntary shiver suppression following cold air/cold water exposure, with and without exercise and/or fatigue. The initial phase of this project also examines the effect of cold stress on rifle shooting performance (rate of fire, accuracy and judgemental shooting) and subjects' performance on a selected battery of command and control relevant cognitive tasks. The relationship of cold exposure and shivering to the ventilatory cycle is also examined, as well as the relative effects of various cold stressors on urinary catecholamine production.

Materials and Methods

Subjects

Male volunteers, 21 to 35 years old and qualified in the use of the M-16 rifle, were solicited from the 148th Fighter Intercepter Group of the Minnesota Air National Guard in Duluth, Minnesota, the St. Louis County Sheriff's Department S.W.A.T. Team, local reserve units and local former military personnel. Each potential subject was informed as to the general purpose, procedure, and possible risks of the experiments and gave his written consent prior to any further screening. Protocols for this project had been approved jointly by the University of Minnesota Committee for the Use of Human Subjects and the United States Army prior to any recruitment.

Selection and Screening

Volunteers were first given a 12-lead Electrocardiogram (ECG) which was interpreted by a licensed physician from the Clinical Science Department, University of Minnesota Duluth School of Medicine. Percent body fat was then estimated by hydrostatic weighing and calculated using the Brozek formula (Brozek, 1963). Volunteers with an abnormal ECG, or exceeding 25% body fat or on prescription medications were disqualified. Volunteers then underwent a treadmill stress test, employing a modified Balke protocol (Blair, 1986). This involved walking on a treadmill at a speed of 3 mph starting at a 2% grade. The grade was increased by 2% every two minutes to a maximum of 18%. Blood pressure and heart rate were recorded during the last 30 seconds at each grade. The volunteer was disqualified if his measured heart rate exceeded 90% of his age predicted maximum heart rate, or systolic blood pressure exceeded 200 mmHg or the diastolic blood pressure exceeded 100 mmHg.

Fifteen subjects who passed all of the above criteria were then familiarized with the experimental protocol. This included instruction and practice in use of the Firearms Training System (F.A.T.S.)(Firearms Training System, Inc., Norcross, Georgia), Complex Cognitive Assessment Battery

(CCAB)(USARI, 1988), step climbing exerciser (Precor 718e, Precor, Inc.) and the rest of the procedures and protocol (electrode hookup, temperature sensor placement and sequence of the experiment). F.A.T.S. scenarios used for this orientation were not used for the experimental trials. Upon completion of the orientation, subjects were assigned to the order that their test would be administered, scheduled for their first experiment and given the Cold Stress Subject Instruction Sheet (see Appendix).

Experimental Conditions

Five experimental conditions were used (see Gant charts, Appendix):

    Condition 1. Cold.
    Condition 2. Cold/wet
    Condition 3. Cold/wet/sleep deprivation
    Condition 4. Cold/wet/exercise
    Condition 5. Cold/wet/sleep deprivation/exercise

These five experimental conditions were counterbalanced among the 15 subjects to control for systematic order effects (see Appendix for counterbalancing design).

Stressors are defined below:

Cold: All experiments were conducted in a 130 square foot environmental chamber thermostatically controlled to operate at $0°±1.0°$ C.

Wet: In four of the five conditions the subjects were periodically required to stand 3-5 seconds in a large container filled to the 15" mark with 10° C water.

Sleep deprivation: In two conditions, subjects were deprived of sleep for 24 hours prior to the beginning of their experiment.

Exercise: In two conditions (during the first hour of cold exposure) subjects were required to exercise for two 12 minute periods on a stepping ergometer at 70% of their age predicted maximum heart rate.

Experiment Preparation

Subjects were instructed to completely empty their bladder approximately one hour before arrival and to note the time of urination. Upon arrival, the subject was instructed to urinate into a sterile beaker, again completely emptying his bladder. The time and volume were recorded and three 7 ml aliquots of the urine sample were frozen in liquid nitrogen for subsequent catecholamine analysis. Subjects were then required to insert a disposable rectal temperature probe (Type T, Sensortek, Inc.) approximately 8 cm past the anus. Surface electromyogram electrodes (Model #D550, AA Biomedical, Inc.) were placed on the trapezius, pectoralis major, biceps brachii, triceps brachii, rectus femorus, biceps femorus and soleus muscles (see Appendix for placement). Skin temperature was monitored on the calf, thigh, upper arm and chest using skin surface thermocouples (Model #SST-1,Type T, Sensortek, Inc.) (see Appendix for placement). Mean skin temperatures were calculated using the following formula: 0.3(chest + arm) + 0.2(calf + thigh) (Ramanathan, 1964). Two ECG electrodes were placed on the chest for cardiac monitoring.

Following instrumentation, the subject dressed in military type fatigue pants, shirt and combat boots (the subject wore his own socks and underwear). Leads from the ECG, EMG, and temperature sites were attached to harnesses on a belt (see Figure, Appendix). The subject could then move about freely without interference from the 31 leads.

Prior to entering the environmental chamber, hand grip strength was measured using a Smedley hand dynamometer in a standing position with arm extended and adducted (Lafayette Instruments, Inc.).

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Experimental protocol

The subject entered the chamber with a technician and EMG and temperature harnesses were interfaced. The subject was then seated quietly on a backless stool and the first measurements were taken.

Temperatures were monitored and recorded every minute using a Macintosh SE microcomputer (Apple, Inc.), interfaced with an A/D board and data handling software (Analog Connection Workbench, Strawberry, Inc.). In addition, five digital temperature monitors (TH-8, Sensortek, Inc.) were used to monitor the surface and rectal temperatures. Temperatures were logged by hand at 5 minute intervals to provide a backup record.

Vertical and horizontal acceleration of the rifle barrel before, during and after shooting was monitored by an accelerometer mounted at a 45° angle on the rifle barrel 5 cm from the end of the muzzle. EMGs and acceleration signals were amplified and monitored on a Nicolet Viking (Nicolet Biomedical Instruments). The signals were also recorded on magnetic tape for subsequent analysis.

Minute ventilation, expired carbon dioxide and oxygen consumption were monitored using a Rayfield open circuit spirometry sampling system (Rayfield, Ltd.) and analyzed using the methodology developed by Rayfield (Rayfield and Carney, 1981; Rayfield, 1982). ECG was monitored by telemetry (Markum Industries). Blood pressures were measured by sphygmomanometer and stethoscope. These variables were recorded every 12 minutes during the first hour and 3 times per hour subsequently.

The first hour of the experiment consisted of exposure to the stressors assigned to that condition, e.g. cold/wet/exercise. During wet protocols, the subject was instructed to step into and out of the water every twelve minutes. For the exercise protocols, the subject was instructed to exercise at the twelve and thirty-six minute mark. Exercise bouts lasted for twelve minutes on a stepping ergometer. The work load was adjusted by increasing or decreasing the climbing rate to maintain the subject's heart rate at 70% (+/- 10 bpm) of his age predicted maximum heart rate. Heart rate was monitored with a wireless heart rate monitor (CIC Heart Watch) providing visual and auditory feedback for the subject. Respiratory and cardiovascular parameters were measured for the last three minutes of each twelve minute segment.

The second hour of the experiment consisted of performance evaluation involving the following: CCAB, F.A.T.S., grip strength, respiratory rate, heartrate, blood pressure and EMGs. In conditions including the wet stressor, subjects were required to step into the water during transitions from F.A.T.S. to CCAB.

These tests were administered in the following time sequence:

CCAB (60 min): "Following Directions"
"Tower Puzzle"

F.A.T.S. (75 min): Rifle Range
Moving Targets

Grip strength (80 min)

F.A.T.S. (81 min): "Quickkill"

CCAB (85 min): "Numbers and Words"
"Route Planning"

Metabolic rate, HR, BP, EMG (100 min)

F.A.T.S. (103 min): Judgemental shooting

CCAB (108 min): "Mark Numbers"
"Missing Items"

The CCAB is a microcomputer based system designed by the Army Research Institute which measures the spectrum of cognitive abilities required in the performance of critical Army command and control, operational tasks. The six CCAB subtests administered provide measurements of attention to detail, perception of form, memory retrieval, time sharing, comprehension, concept formation, verbal reasoning, quantitative analysis, planning, situation assessment, decision making, problem solving and creativity. The CCAB instructions and cognitive tasks

were displayed on a CRT screen located outside the chamber, which the subject viewed through a 24" x 48" window. The subjects responded to CCAB test questions by typing answers on a keyboard mounted in front of the window inside the chamber, and this keyboard was connected to an externally mounted microcomputer (IBM PS/2, Model 30/286).

The Firearms Training System combines features of several technologies, notably: interactive video-disc/computer technology and laser designator/camera/computer/target-hit generation, which provides for immediate visual performance feedback. The subject is presented with a series of 'scenarios' projected at lifesize onto a screen at the end of the chamber from a videodisc player/projector. When the F.A.T.S. weapon is fired, a laser emitter is triggered and the laser shot pattern on the screen is immediately identified by the camera and recorded by microcomputer. The F.A.T.S. calculated and recorded, where applicable, reaction time, judgement, number of hits and or misses, and accuracy scores. During the Rifle Range simulations, movement of the rifle barrel during sighting was monitored using an accelerometer (GY 125-10, Kulite Semiconductor Products, Inc.) attached to the end of the barrel. The following is a brief description of the F.AT.S. simulations employed. All shooting was done from a standing position with a modified AR15-2 rifle.

Rifle Range Course

Each subject was allotted one minute to fire ten shots at a stationary NRA target at a simulated distance of 100 yards. Reloading was required after five shots. This sequence was repeated four times for a total of forty shots at four separate targets.

Moving Targets

The subject was allowed to fire eight rounds at eight pop-up or moving targets.

"Quick Kill"

The subject was given 54 shots to fire at 54 targets of differing sizes and shapes, which flashed on the screen rapidly in random locations over a period of 30 seconds.

Judgemental Shooting

The subject was presented with 5 realistic audio-visual scenarios depicting situations which may require the use of the weapon (2 no-shoot and 3 shoot situations presented in random order). The scenarios used in Phase I of the experiments were selected from the 40 existing standard simulations accompanying the F.A.T.S. system, currently configured for law enforcement officers. Scenarios were selected so that a subject was exposed to different scenarios in each condition. The scenarios were drawn from the FBI Police Officer Killed statistics and filmed at the Federal Law Enforcement Training Center at Glynco, Georgia. All of these scenarios were scripted from actual incidents in which deadly force was required or where it was used in error. Some of the scenarios had a similar beginning but ended in either a "Shoot" or "No-Shoot" situation. The subject was required to anticipate the different threat levels associated with the various weapons depicted in the scenarios--knives, handguns, rifles, shotguns, etc. and respond appropriately. The subject was instructed to fire the weapon at least twice if he judged the scenario to be a shoot situation. The scenario continued until two hits were registered or the threat was over.

The last portion of the experiment included continued monitoring and collection of metabolic data (respiratory parameters, heart rate, BP, temperature, EMG) and evaluation of four shiver suppression techniques. The sequence for these tests was as follows:

respiratory parameters, HR, BP, EMG	123 min
shiver suppression techniques	126 min
respiratory parameters, HR, BP, EMG	140 min
end of experiment	143 min

Shiver suppression

Subjects were instructed to stand and refrain from any voluntary movements during this time as shivering was monitored by EMG activity. Each shiver suppression technique was preceded by two minutes of normal shivering to provide control data.

Four shiver suppression methods were employed:

(1) Breath hold: The subject was instructed to hold his breath for 30 seconds.
(2) Relax: The subject was instructed to stand still and attempt to relax his entire body for one minute .
(3) Warm Water: The subject was instructed to drink a six ounce cup of warm (50° C) water within one minute.
(4) Mental Arithmetic. Two columns of random two digit numbers were displayed side by side on a sheet of paper. The subject was instructed to add as many of these pairs together as he could in one minute.

The instructions for each shiver suppression method were typed on a card and placed face down in front of the subject. After standing for two minutes, the subject read the first shiver suppression card and followed the instructions when signalled to proceed. This same procedure was repeated until all four shiver inhibition techniques were completed. Upon leaving the chamber the subject was disconnected from the electrodes and thermocouples. After a final urine sample was collected, the subject was allowed to leave when he felt comfortable.

Catecholamine Analysis

Urine from three healthy male subjects from outside the test subject group were pooled and used as a standard. The catecholamine concentration of this standard is determined by the method of standard additions. One standard is then run in parallel with every group of 5 or

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less unknown samples obtained from the test subjects. The samples are purified and concentrated for injection on a HPLC by the following steps:

1. 5 ml of a previously thawed urine sample is spiked with 50 ug/ml solution of dihydroxybenzylamine (DHBA). The DHBA acts as an internal standard.

2. The sample is then put onto a miniature cation exchange resin column. After the column has drained completely it is rinsed with 10 ml of distilled water to remove impurities not retained by the column. To elute the catecholamines from the resin the column is acidified with slightly less than one void volume of 0.7 M H_2SO_4. This serves to desorb the catecholamines from the resin. The displaced catecholamines are then eluted from the column with 4 ml of 2M $(NH_4)_2SO_4$ and collected in a 5 ml conical reaction vial.

3. 50 mg of alumina and 0.5 ml 3M tris pH 8.6 are added to the vial and agitated 10 min. on a shaker to facilitate adsorbtion of the catecholamines to the alumina. After the sample has settled the supernatant is aspirated and discarded. The alumina is rinsed once with 1 ml of distilled water and aspirated again. The catecholamines are desorbed from the alumina with 0.2 ml of 0.1 M $HClO_4$. The catecholamine containing acid extract is then microfiltered and ready for injection on the HPLC.

HPLC System Parameters

Liquid chromatograph: Bioanalytical Systems (BAS) LC-304

Stationary Phase: Sherisorb ODSII, 5 um column (25x4.6 mm)

Detector: BAS LC-4A/LC-17, using glassy carbon electrode, applied potential +650 mV vs Ag/AgCL

Mobile Phase: 0.15 M monochoroacetate buffer pH 3.10, containing 2 mM Na_2EDTA, 50 mg/L sodium octyl sulfate, 2.44% acetonitrile

Flow Rate: 1.0 ml/min.

Column Temperature: 30° C.

Recorder: Stripchart

HPLC Data Analysis: The following equations were used to determine catecholamine excretion and catecholamine concentration (by using the ratio of each catecholamine peak height to the DHBA peak height in the calculations the need to consider absolute recovery is removed):

Catecholamine concentration (ng/ml) =
peak height ratio (unknown) / peak height ratio (urine pool) x urine pool concentration (ng/ml)

Catecholamines excreted =
concentration (ng/ml) x sample volume (ml) / collection period (min.)

RESULTS

Grip Strength

Pre and post grip strength measurements within each condition are reported in the Appendix, Table 1. Post-test grip strength means were significantly lower than pre-test means for all conditions (paired t-test, $p < .05$). The average decrease in grip strength following cold exposure ranged from 7.43% in condition five to 12.66% in condition three, with average decrements of 9.96%, 9.11% and 10.61% in conditions one, two and four respectively. There was, however, no statistically significant difference in grip strength decrement across conditions (one-way ANOVA).

Complex Cognitive Assessment Battery

The performances of all subjects on each of the subtests of the Complex Cognitive Assessment Battery (CCAB) in each condition are

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presented in Tables 2, 3, 4, 5, 6, and 7 in the Appendix. Due to unanticipated problems with the hard disk drive system of the microcomputer used to collect the CCAB data, several subject data files were electronically erased and not retrievable. Incomplete data sets are available for all subtests, and only six of the thirteen subjects have data available for all subtests across all conditions.

Across conditions, the highest scores were generally achieved in condition 2. Condition 2 (Cold, Wet) had the highest average score of any condition for five of the six CCAB subtests (Following Directions, Tower Puzzle, Mark Numbers, Route Planning and Missing Items). There were relatively no observed differences across CCAB subtests for conditions 1, 3, 4 and 5, however, and there was no statistically significant overall effect on CCAB subtest scores across conditions. Although subjects were sleep deprived in conditions 3 and 5, sleep deprivation of 24 hours duration did not contribute to significant declines in cognitive performance on the CCAB, nor did exercise contribute to significant decrements or increments.

Changes in Mean Skin and Rectal Temperatures

Changes in rectal and mean skin surface temperatures for each subject following exposure in each condition are presented in the Appendix, Tables 8 and 9. Mean skin temperature fell an average of 6.2° C during the exposure time, with average drops in temperature of 6.4, 6.3, 6.1, 5.9 and 6.3° C seen in conditions 1, 2, 3, 4, and 5 respectively. The greatest amount of mean skin temperature cooling occurred within the first 75 to 85 minutes of exposure and relatively little further cooling was demonstrated in the last 50-60 minutes of exposure. There was no statistically significant difference in the rate of fall of the mean skin temperature or the shape of the cooling curves across conditions (see Figure 1).

Rectal temperatures fell an average of 0.2° C over the course of the exposure time, with average drops in temperature of 0.3, 0.2, 0.2, 0.3, and 0.2° C for conditions 1, 2, 3, 4 and 5 respectively. There were no statistically significant differences between the rate of fall of the rectal temperatures or the shape of the cooling curves for conditions 1, 2 and 3 (see Figure 1).

Rectal Temperatures (°C)

Mean skin temperatures (° C)
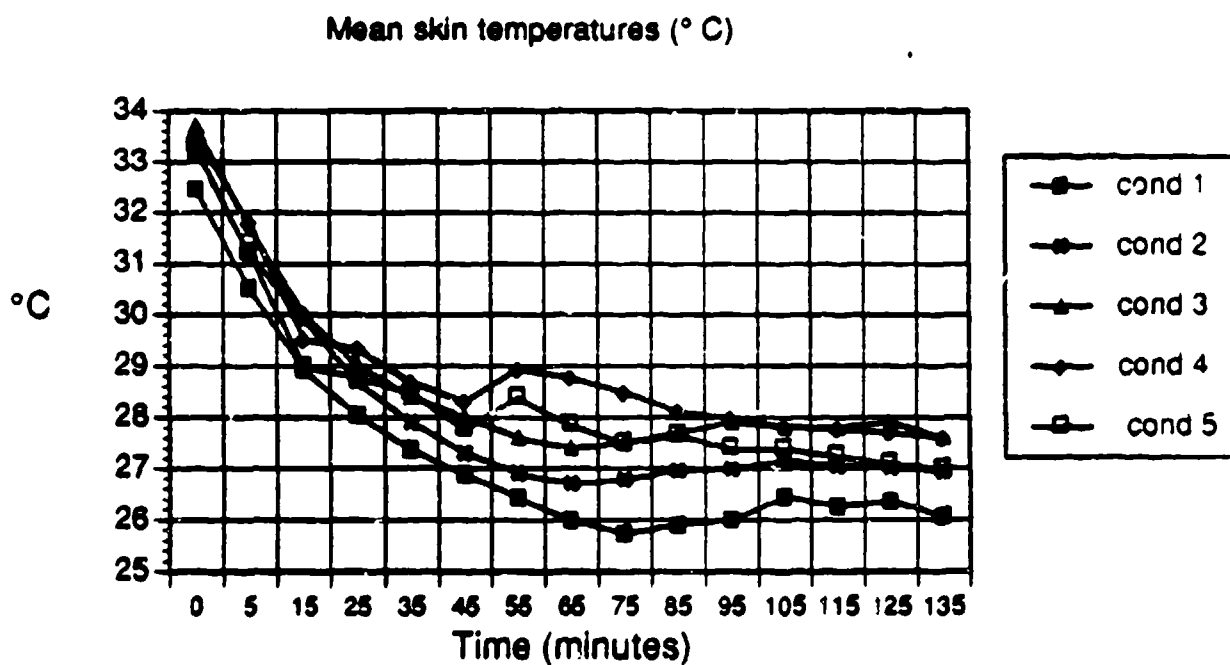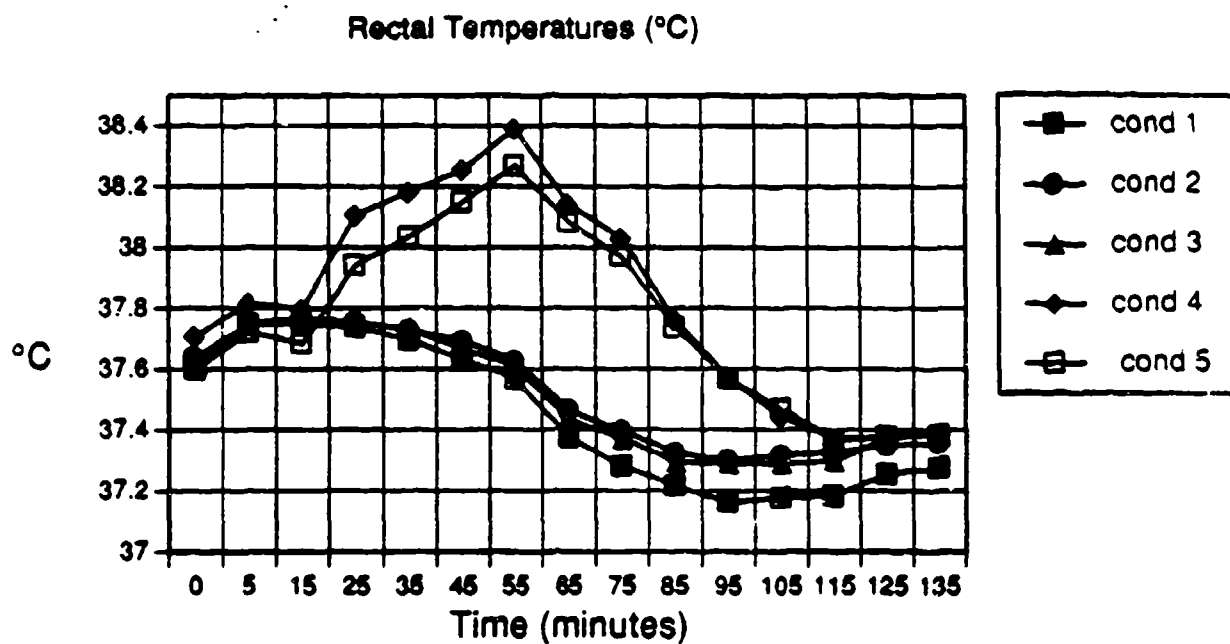
Figure 1. Rectal Temperatures and Mean Skin Temperatures by Condition

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The cooling rate in condition 4 (cold/wet/exercise) was significantly different (p<.05) from the cooling rate of condition 2 (cold/wet), with rectal temperature increases seen in condition 4 following the onset of exercise at minute twelve. Although exercise was discontinued at minute 48 of the protocol in condition 4, the core (rectal) temperature rise continued until minute 55 and cooling did not reach the level seen in condition 2 until approximately minute 115. In like manner, the cooling rate in condition 5 (cold/wet/sleep deprivation/exercise) was significantly different (p<.05) than the cooling rate of condition 3 (cold/wet/sleep deprivation), again following the onset of exercise in condition 5 at minute 12 of the protocol. The shape of the cooling curves for conditions 4 and 5 were not statistically significant from one another, and the cooling level in condition 5 reached the cooling level of condition 3 at approximately the 115 minute mark.

Rifle Shooting Performance - Firearms Training System (F.A.T.S.)

a. Rifle Range Course

The shooting performances of all subjects on the simulated 100 yard Rifle Range Course in each condition are presented in Table 10 of the Appendix. There were no significant differences in the average score across conditions for the 4 targets presented. The target acquisition time, however, was significantly (p<.05) faster in conditions 4 and 5 (Cold/Wet/Exercise and Cold/Wet/Sleep Deprivation/Exercise), presumably due to the effect of exercise in these conditions prior to minute 75, when the shooting for the rifle range course began.

b. Moving Target Range Course

The shooting performances of all subjects on the Moving Target Range Course in each condition are presented in Table 11 of the Appendix. There were no statistically significant differences across conditions for either number of target hits or the percentage of hits to number of shots fired (ANOVA, p<.33, p<.22 respectively).

c. Quick Kill Course

The shooting performances of all subjects on the Quick Kill Range Course (rapid fire) in each condition are presented in Table 12 of the Appendix. There were no statistically significant differences in shooting performance across conditions for either the number of hits, the percentage of targets hit or the percentage of hits to shots fired, although slightly better average performance occurred in condition 1 across all three of these performance indices and generally the poorest performance occurred in conditions 2 and 5.

d. Judgemental Shooting

The shooting performance of all subjects reacting to the shoot/no shoot video scenarios in the Judgemental Shooting course in each condition are presented in Table 13 of the Appendix. There were significant differences in the reaction times between the threat presented in the scenario and the elapsed time to the subjects' first shot, with significantly slower reaction times observed in conditions 1 and 2. Upon careful examination of the scenarios randomly chosen for conditions 1 and 2, it appears that by chance the scenarios viewed by subjects in condition 1 contained targets that were more difficult to acquire and hit, and in the scenarios selected for condition 2 there appeared to be a greater likelihood of making shoot or no shoot errors due to the actual scenes portrayed and the way in which they were filmed. For these reasons, the significantly longer reaction times seen in conditions 1 and 2 were more likely due to inadvertent bias in the difficulty of the scenarios than an effect due to the experimental conditions themselves. In similar fashion, the significantly lower percentage of good judgement decisions made in condition 2 in shoot/no shoot situations was likely a function of task difficulty, as was the significantly poorer shooting accuracy seen in condition 1. Upon further close inspection there was no evidence to suggest that there was an inherent bias in the scenarios for conditions 3, 4, and 5, and there was consequently little evidence to suggest that exercise or sleep deprivation had a significant effect upon judgemental shooting performance.

Urinary Catecholamine Excretion and Urine Production

Urine catecholamine excretion was determined for a minimum of a one hour period prior to each experiment and for the duration of the test protocol. The catecholamine concentration of the pre & post urine samples was measured by HPLC, as previously described, and then multiplied by mean urine flow rate. The mean urine flow was calculated by dividing the voided volume by the collection time period.

The excretion of epinephrine, norepinephrine and dopamine was not significantly different when the control (pre-test) samples were compared between the five test conditions and when the post excretions were compared between the five test conditions (see Figures 2, 3 and 4). In all cases the epinephrine and norepinephrine excretion was greater during the test period for all five conditions (see Figures 2 and 3). Statistical analysis, employing the paired Student t-test, indicated that the epinephrine excretion during the cold exposure (post) was significantly higher ($p<0.05$) than the control (pre) value in conditions 2, 4 and 5. The norepinephrine excretion during the cold exposure (post) was significantly higher ($p<0.05$) when compared to the control (pre) value in all conditions (1 through 5). There was no significant difference in dopamine secretion between control (pre) and cold exposure (post). If the epinephrine and norepinephrine data is treated as the ratio of epinephrine to norepinephrine (see figure 5), there is no significant difference between control (pre) and cold exposure (post) or between the five conditions.

The pretest urine flow rate showed considerable variation between individuals and conditions. Therefore, the urine flow is presented as percent change from control as follows:

% change in urine flow = (experimental - control urine flow) x 100
                          control urine flow

This data is summarized in Figure 6. During conditions 1, 2 and 4 the urine flow increased during the test period, with the maximum increase occurring in condition 4 (Cold Air/Cold Water/Exercise) of 130% ($\pm$ 36%
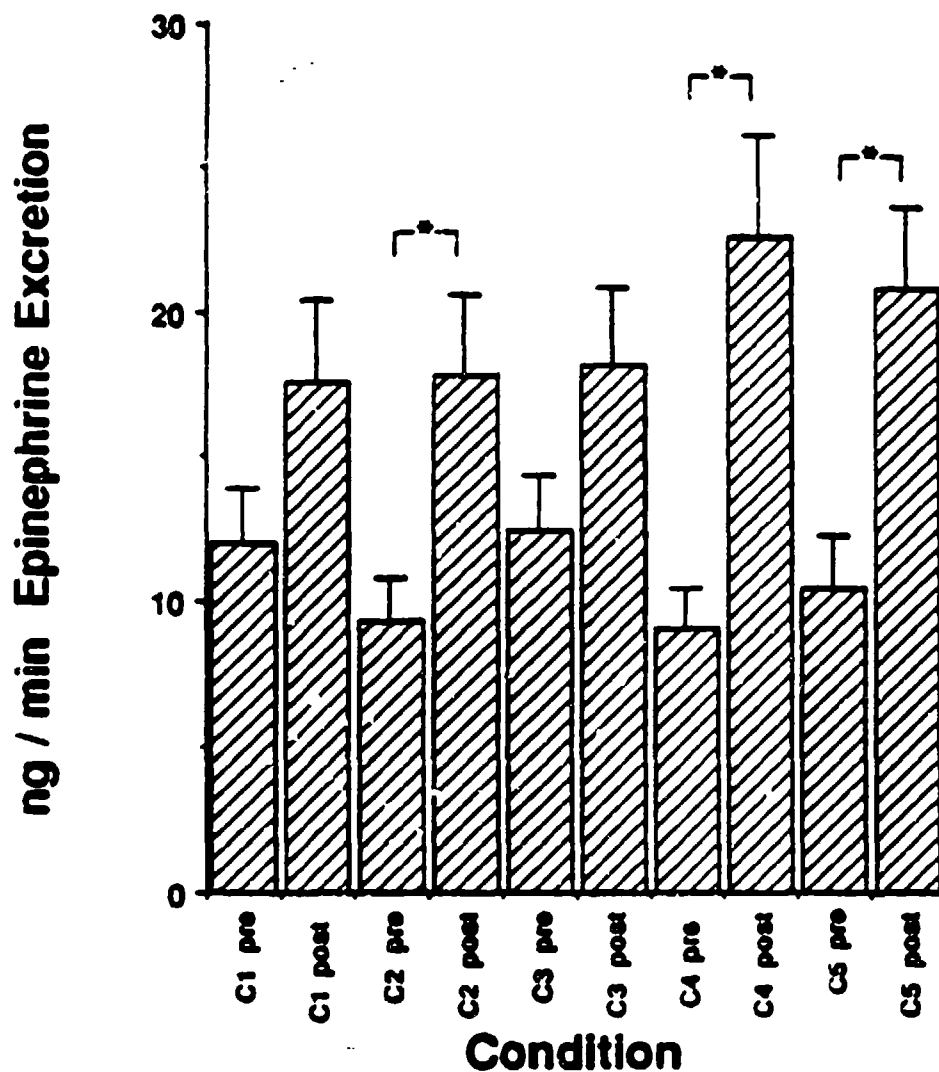
Figure 2
Excretion rate of epinephrine prior to (pre) and during (post) cold exposure for the five test conditions. The * indicate those conditions in which the excretion during cold exposure was significantly (p<0.05) different than that prior to the experiment. There is no significant difference between conditions. Error bars represent one standard error of the mean.

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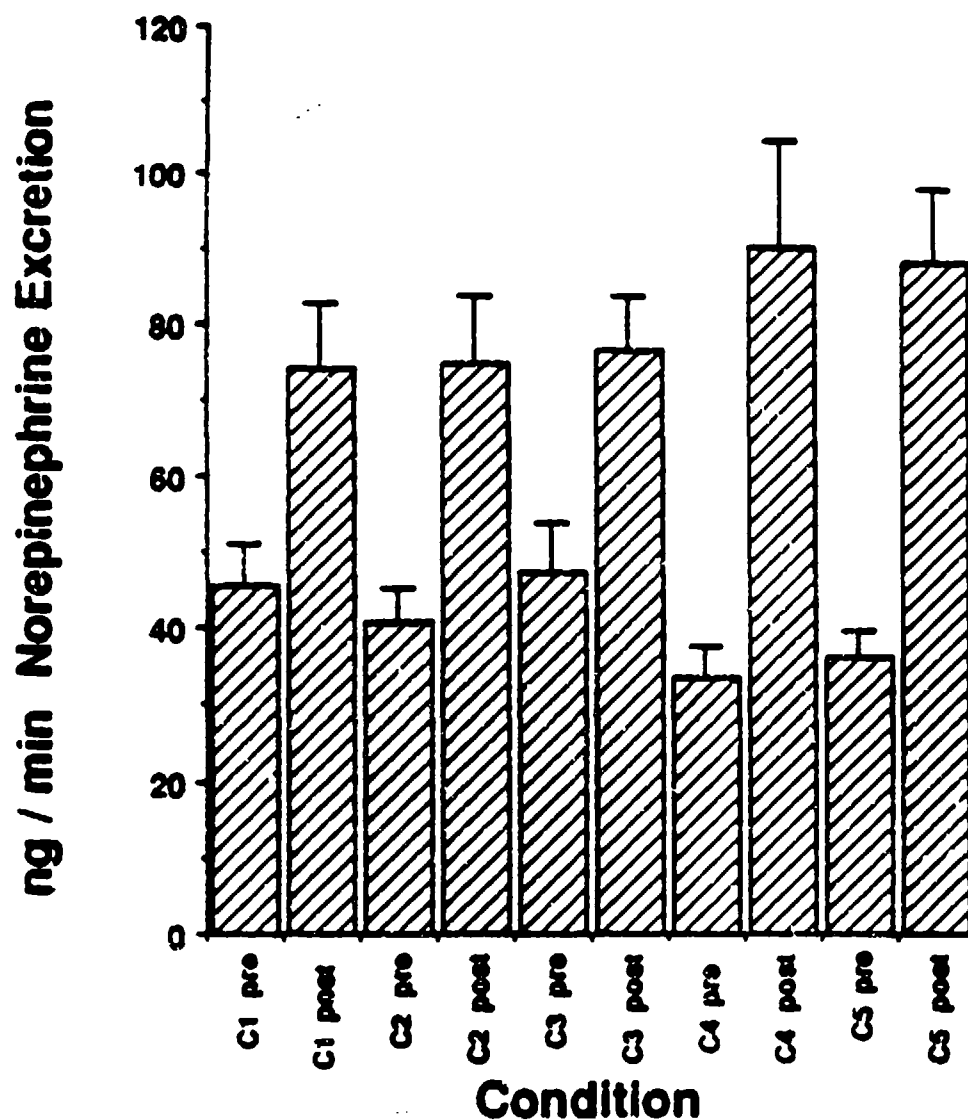
Figure 3
Excretion rate of norepinephrine prior to (pre) and during (post)
cold exposure. All pre - post comparisons are significantly
($p < 0.05$) different, however there is no significant difference
between conditions. Error bars represent one standard error of
the mean.
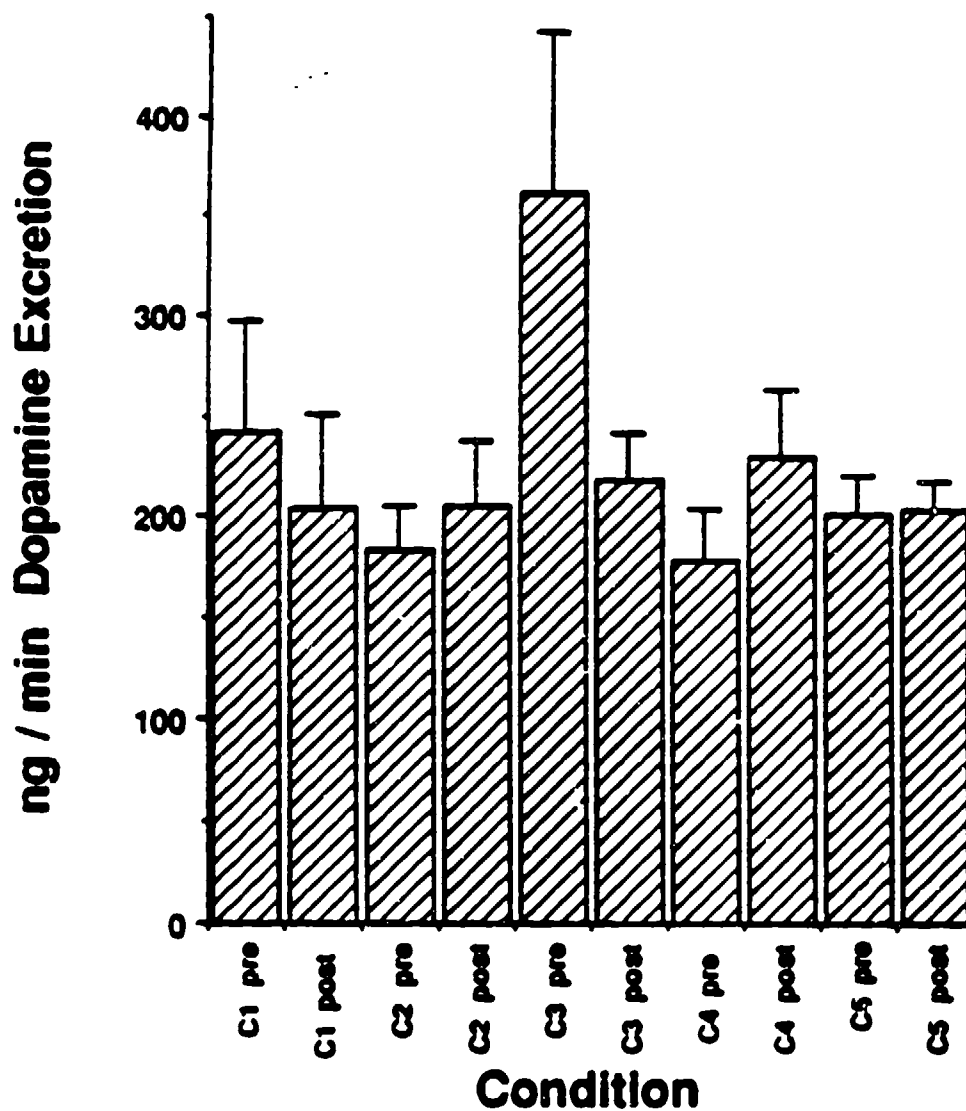
Figure 4
Excretion rate of dopamine prior to (pre) and during (post) cold
exposure. None of the pre - post comparisons are significantly
different nor are there any differences between conditions. Error
bars represent one standard error of the mean.

Figure 5
.e ratio of epinphrine to norepinephrine excretion is presented
for the period prior (pre) and during (post) cold exposure for the
five experimental conditions. There was no significant difference
nor any difference between conditions. Error bars represent one
standard error of the mean.
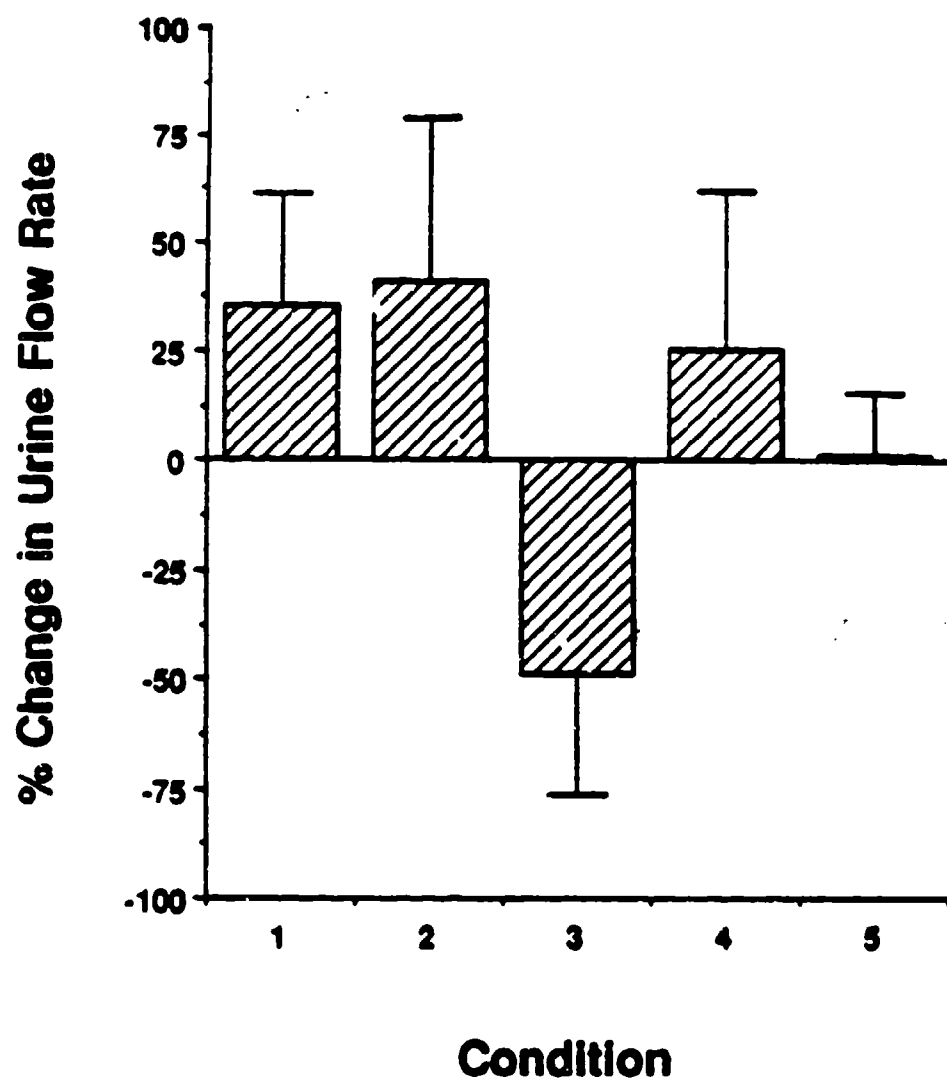
Figure 6
Urine flow rate for the five test conditions expressed as percent change from control. Condition 1 vs condition 3 were significantly different (p<.0.04). Error bars represent one standard error of the mean.

SEM). In condition 3 (Cold Air/Cold Water/Sleep Deprivation) there was a decrease in urine flow of 48% ($\pm$ 27% SEM). Finally, under condition 5 (Cold Air/Cold Water/Exercise/Sleep Deprivation) the urine flow showed no change from control values.

Shivering

The monitoring of shivering activity was accomplished by the electromyographic recording of seven muscle groups. The EMG signal was sampled at predetermined times (24, 36, 48, 60, 100, 125, and 145 min.) during the cold exposure. A 30 second sample of each EMG was obtained via analog to digital conversion and the root mean square (RMS) voltage was computed by the following algorithm:

$$\text{RMS} \; = \; \sqrt{\frac{y_1^2 + y_2^2 \cdots y_n^2}{n}}$$

Due to the moderate nature of the cold stress to which the subjects were exposed, observable shivering did not occur during the initial 15 to 20 minutes in the chamber. In order to obtain a measure of baseline muscle activity or tone, RMS value was therefore evaluated at 12 minutes into the cold exposure. This was considered the control value and all other RMS determinations were expressed as changes from control.

The first approach to analyzing the subjects' shivering during the exposure period was to average the RMS values for all seven muscles at each of the time periods and for each condition. This data is summarized in Figure 7. Onset of shivering varied depending on the condition. The earliest onset occurred in condition 1 (cold air alone). Shivering reached a maximum during the second half hour of the exposure and then decreased early in the second hour and remained at the same low level during the remainder of the exposure. Note that between 100 and 145 minutes the magnitude of shivering is lowest in the condition 1 group.

In all other conditions (with the exception of condition 3 at 60 minutes) the magnitude of shivering is less than condition 1 up to the 60
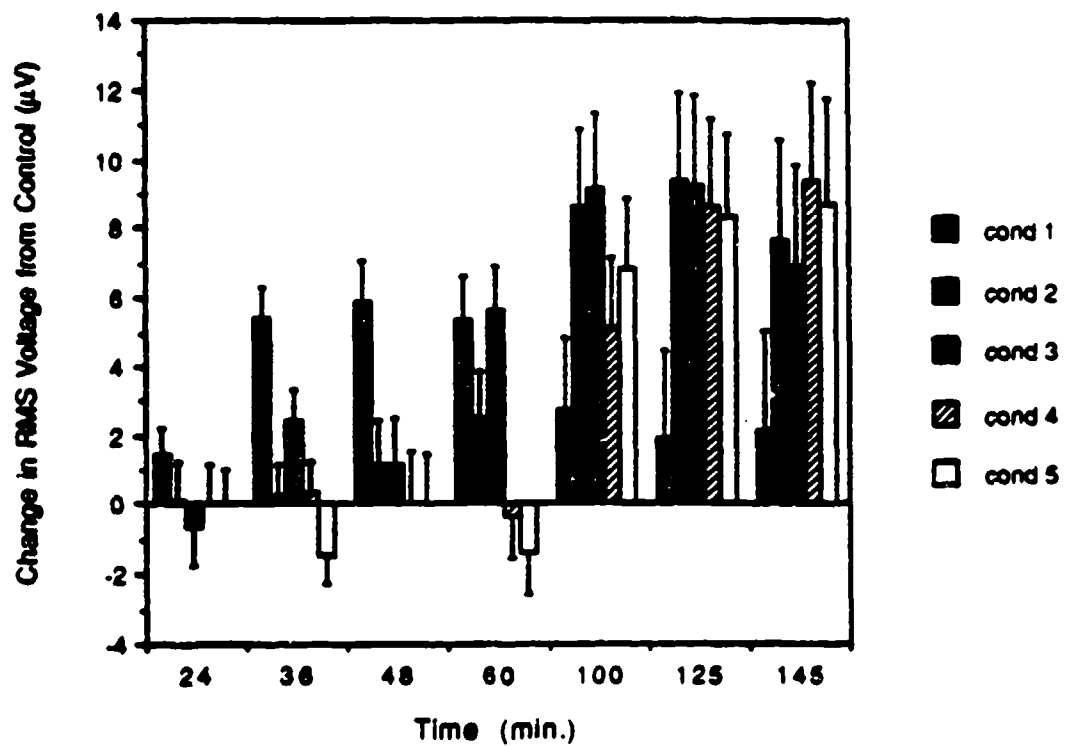
Figure 7. For each subject and condition the difference between mean RMS voltage at 12 minutes (control) and each subsequent time was computed. The mean ± 1SEM of all seven muscles is presented here.

minute point. After the 60 minute point, the magnitude of shivering exceeds that of condition 1 and is essentially the same for conditions 2 through 5, remaining at that level until the end of the exposure period.

In both conditions incorporating an exercise component (conditions 4 and 5), the onset of shivering as indicated by the RMS analysis was delayed until after the two exercise bouts. Nonetheless, by the end of the test condition, shivering had reached the level observed in conditions 2 and 3. In fact, the electrical activity in the muscle following exercise, in conditions 4 and 5, was equal to - or actually less than - the nonshivering control measurements taken after 12 minutes of exposure.

The use of the mean RMS value of the seven muscle groups may to some extent cover up the response and activity of the individual muscle groups during the cold exposure. The RMS data for each muscle monitored, under each of the five conditions, is therefore presented in Figures 8 through 12. Regardless of the condition, the trapezius shows the greatest overall activity once shivering begins. In condition 1, the activity in the trapezius begins after the 36 minute point and remains high through the second hour+ of the test. The six other muscles monitored show some (but minimal) shivering at the 60 minute mark and beyond, with essentially no difference in shivering intensity between muscles (see Figure 8).

In condition 2 (Cold Air/Cold Water) shivering intensity became significant after the first hour, with the largest RMS values again seen in the trapezius. Under these test conditions other muscle groups show an increased activity; these include the pectoralis major, triceps and the rectus femoris (see Figure 9).

With the addition of sleep deprivation (condition 3), shivering tends to occur earlier in all muscle groups and is well established by 60 minutes into the test, with shivering less dominated by the trapezius. The pattern of shivering intensity is more consistent, both between muscles and over time, from 100 minutes to the end of the test (see Figure 10).

In conditions 4 and 5, two 12 minute exercise protocols were included in the first hour of cold exposure (at 12 and 36 minutes). In both of these conditions significant shivering (as indicated by the RMS values) did not occur until 100 minutes into the exposure and/or 52 minutes after the end of the second exercise protocol (see Figures 11 and 12). The RMS values in condition 5, measured after the exercise protocols at 36 and 60 minutes,

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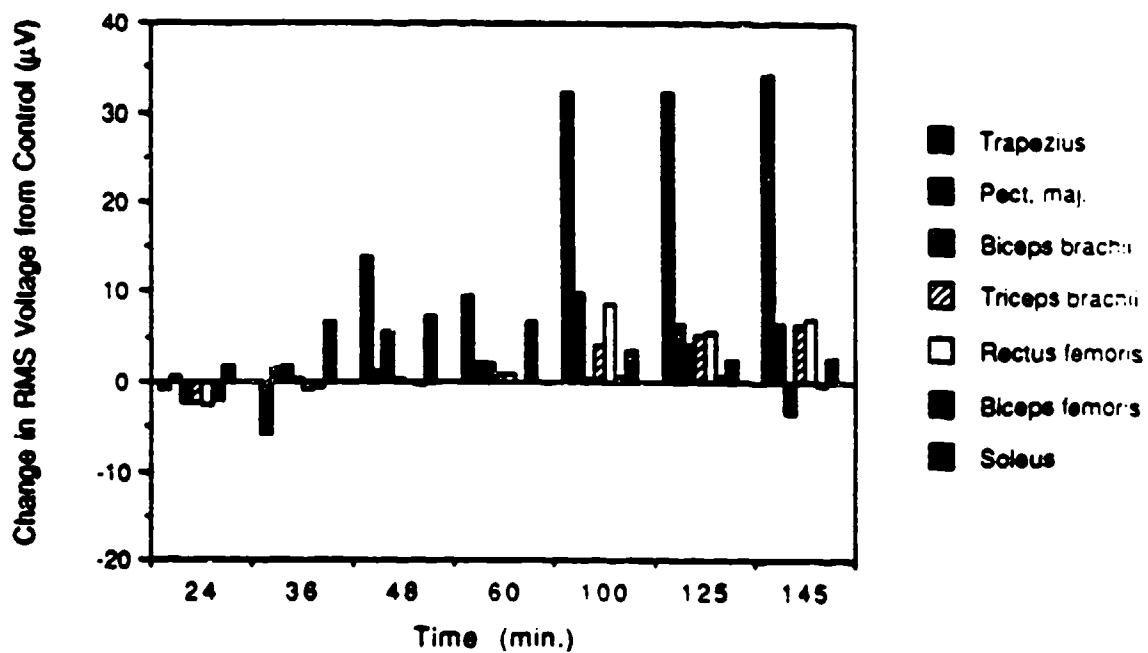
Figure 8. The change in RMS values for each muscle group over time under the condition 1 protocol.
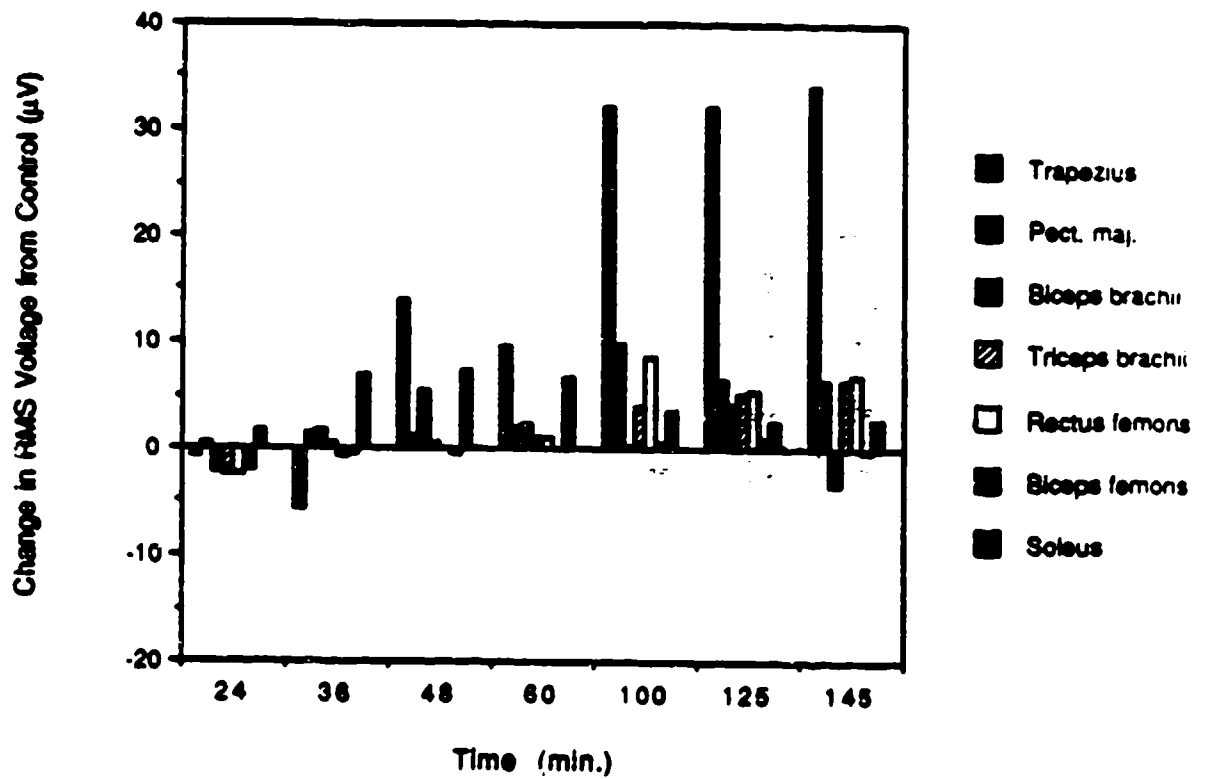
Figure 9. The change in RMS values for ech muscle group over time under the conditon 2 protocol.
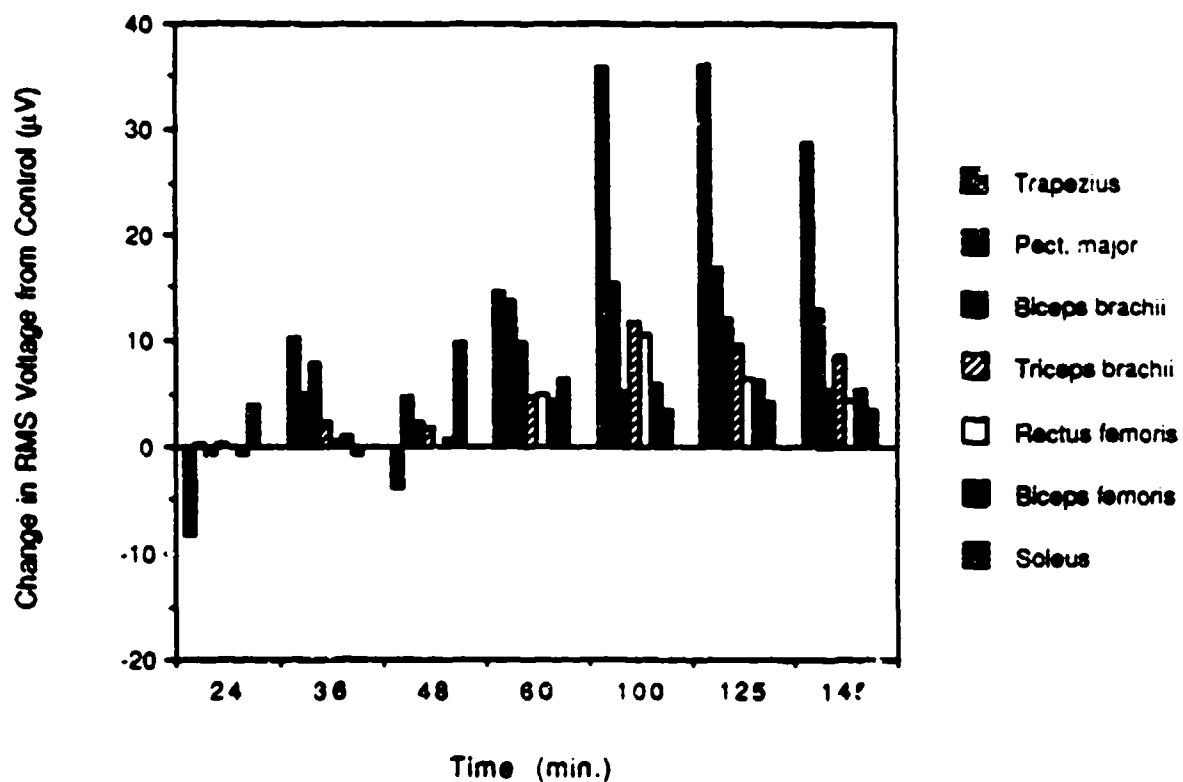
Figure 10. The change in RMS values for each muscle group over time under the condition 3 protocol
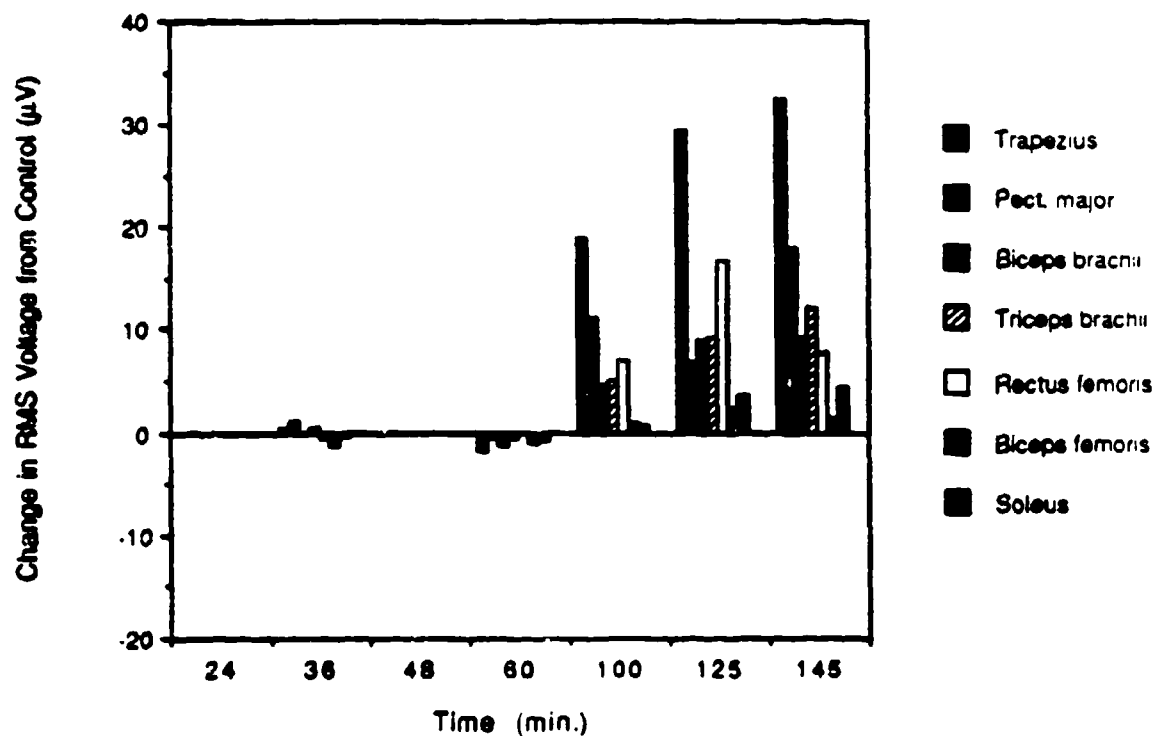
Figure 11. The change in RMS values for each muscle group over time under the condition 4 protocol.
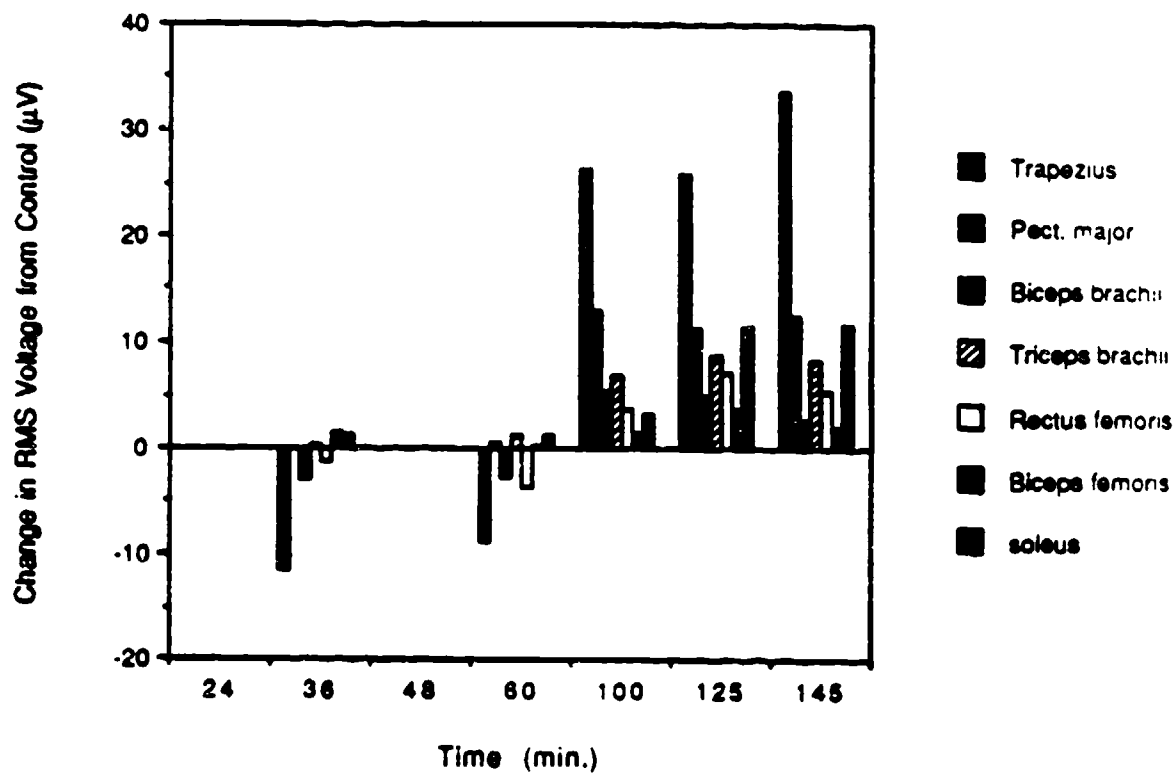
Figure 12. The change in RMS values for each muscle group over time under the Condition 5 protocol.

give values that are less than that of the control muscle tone measured at 12 minutes into the exposure. The trapezius is less dominant, with the pectoralis major, biceps, triceps and rectus femoris becoming more prominent.

Individual muscle RMS as a function of condition over time are presented in Figures 13 through 19. Although this data is contained in the earlier figures, this data presentation makes it easier to see the response of the individual muscle groups to the length of exposure in each condition. The trapezius, pectoralis major, triceps and rectus femoris (Figures 13, 14, 16 and 17) show the most consistent pattern of activity over both time and between conditions. The biceps and soleus (Figures 15 and 19) show the least overall activity as well as the most variability over both time and between conditions.

Detailed tabular EMG - RMS data for all subjects, all muscle groups, conditions and times is included in Table 16 of the Appendix.

Shivering was expected to result in increased movement of the rifle during the target shooting portion of the experiment. In order to monitor the movement an accelerometer was attached to the barrel and the voltage output representing acceleration was recorded. The acceleration data was analyzed in the same manner as the EMG output, i.e. RMS voltage with the appropriate calibration factor to express the end result in units of acceleration. Figure 20 presents the acceleration data for the five conditions. In each condition the acceleration signal was analyzed following the 1st, 4th and 31st shots (each subject was allowed 10 shots at each of 4 targets for a total of 40 shots). The acceleration was somewhat higher for condition 2, shots 1 and 3. However, there was no statistically significant difference between shots or between conditions.

Shiver Suppression

In order to evaluate the shiver suppression techniques, a control RMS value was calculated as follows: the RMS values for all muscle groups were obtained while the subjects were shivering, over a 30 second period during the two minutes prior to the suppression maneuver, and this value was used as the control RMS value. The RMS value was then recomputed after the onset of the suppression maneuver, and this value was used as the
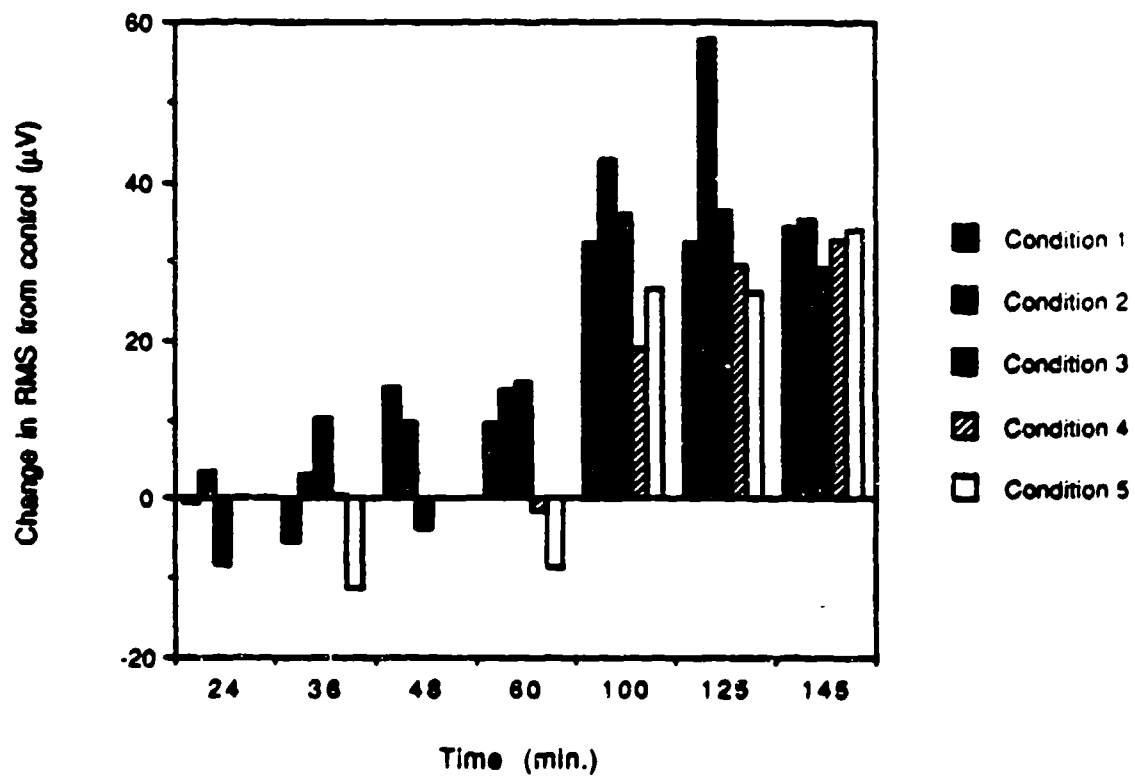
Figure 13. The ct. nge in RMS from control for the Trapezius muscle as a function of time for the five conditions.

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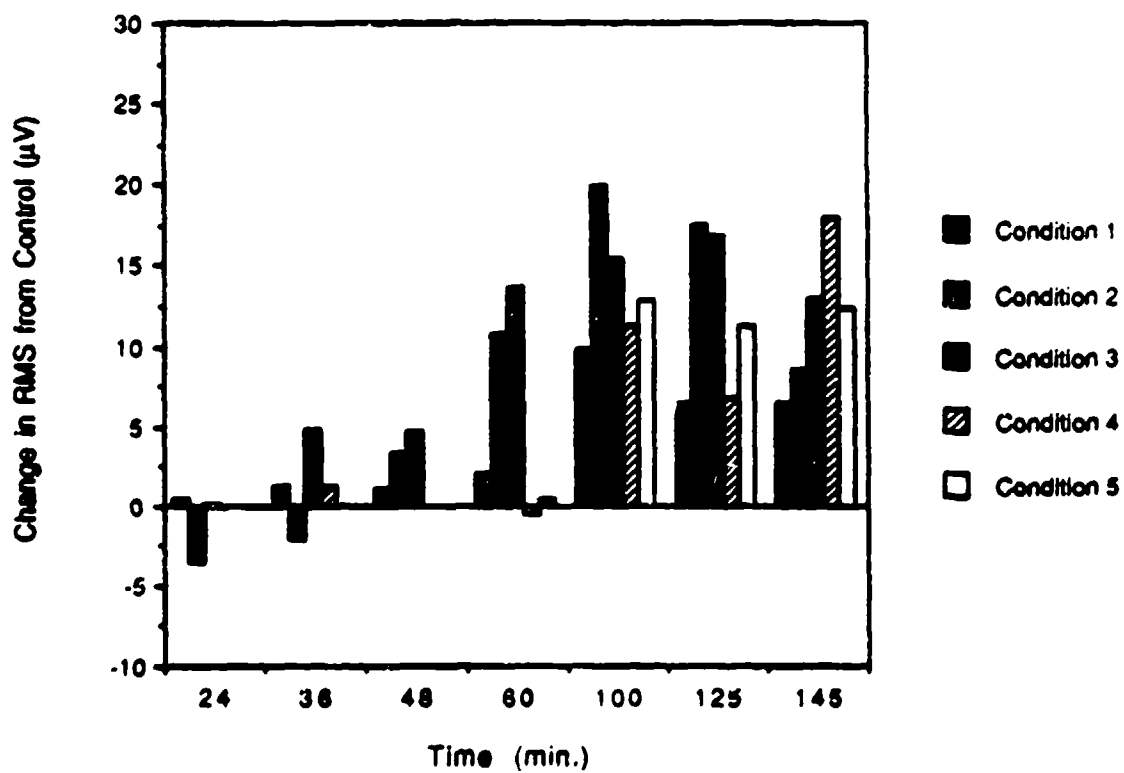
Figure 14. The change in RMS from control for the Pectoralis major muscle as a function of time for the five conditions.
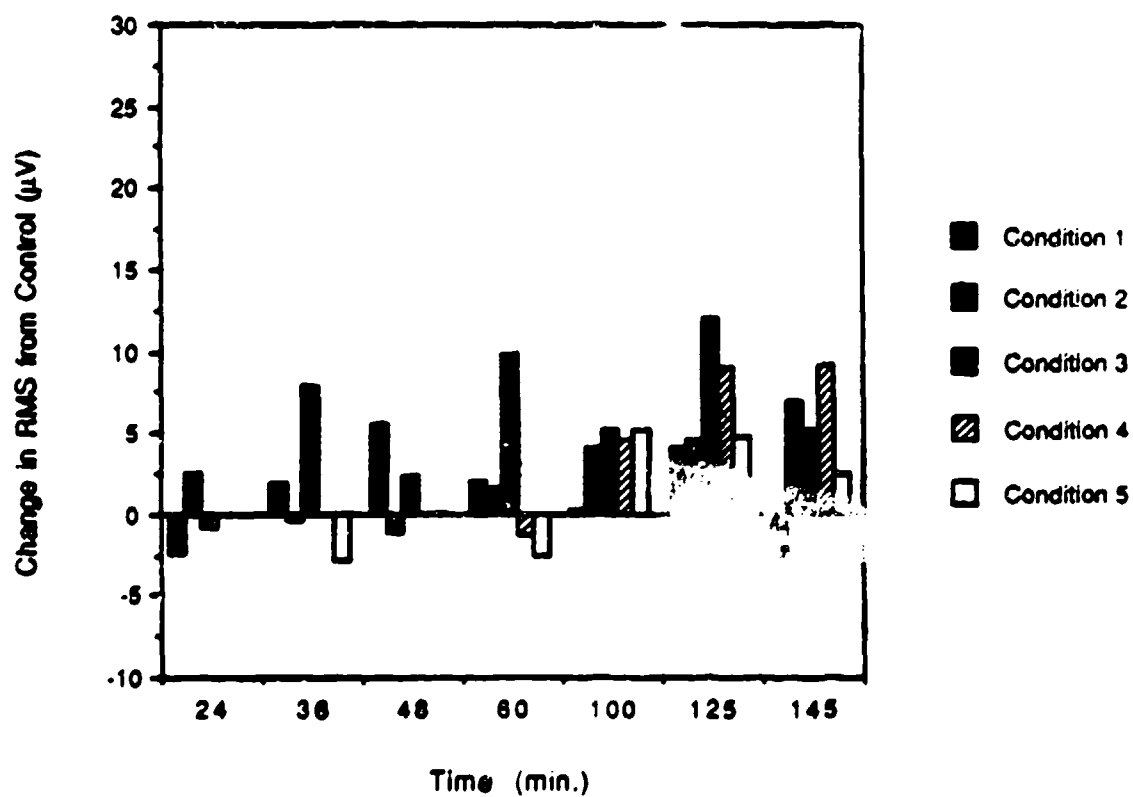
Figure 15. The change in RMS from control for the Biceps brachii muscle as a function of time for the five conditions.
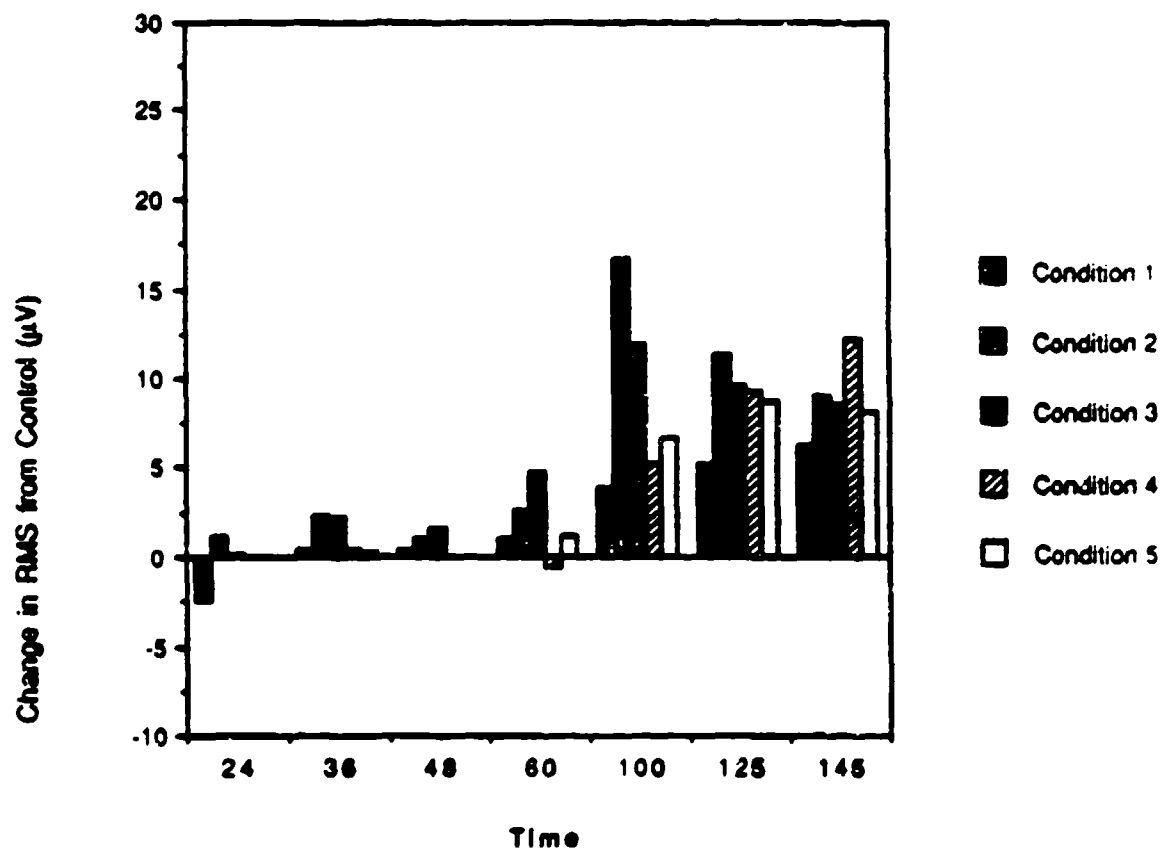
Figure 16. The change in RMS from control for the Triceps brachii muscle as a function of time for the five conditions.
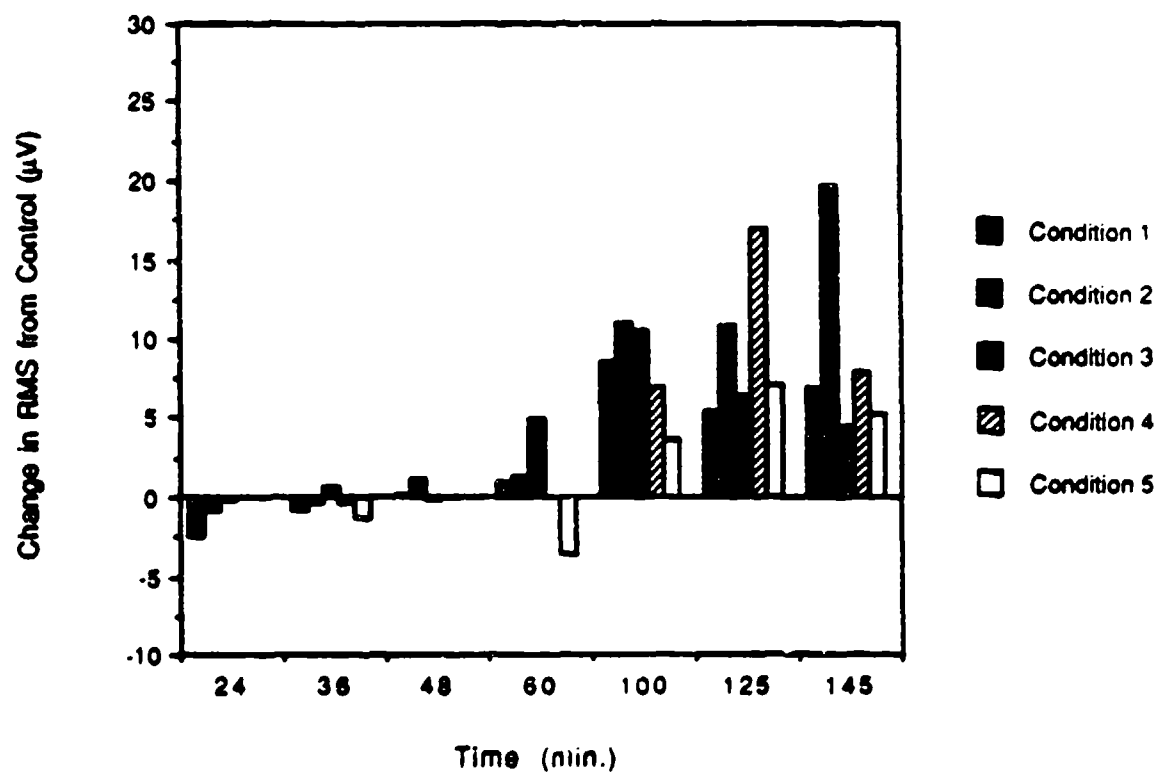
Figure 17. The change in RMS from control for the Rectus femoris muscle as a function of time for the five conditons.
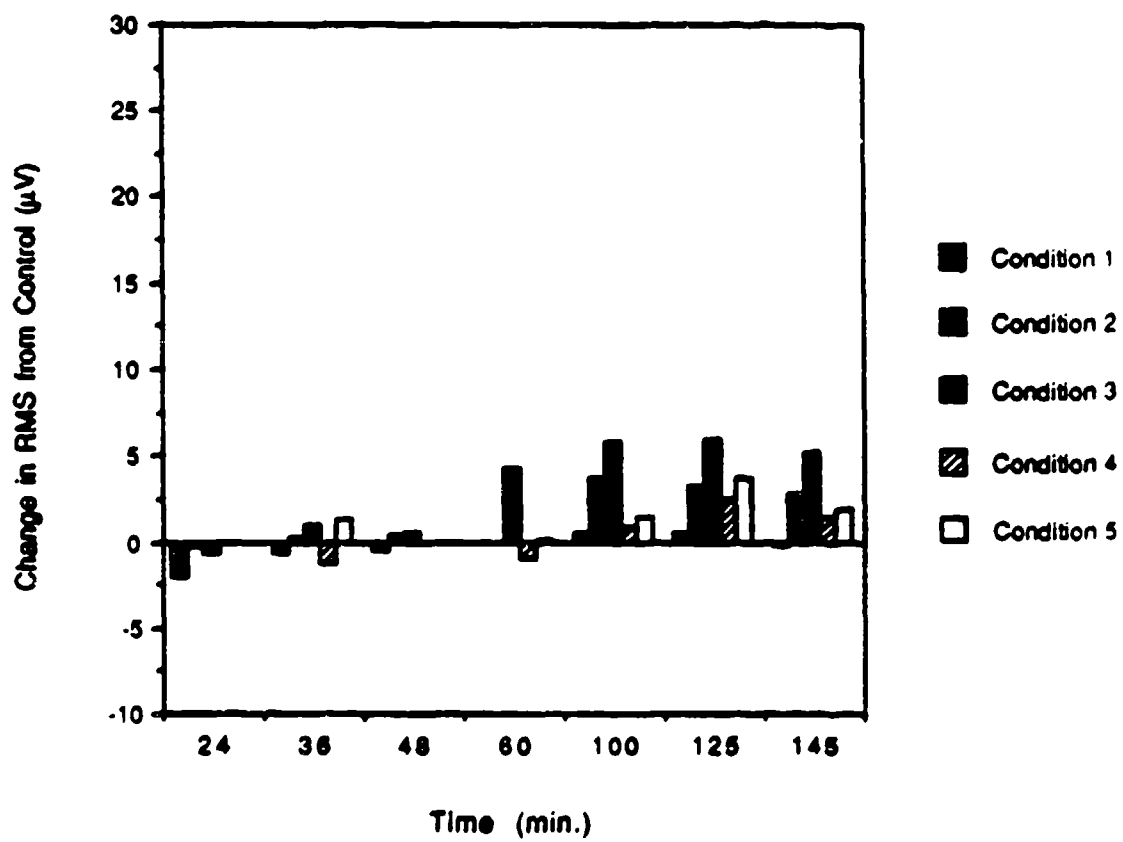
Figure 18. The change in RMS from control for the Biceps femoris muscle as a function of time for the five conditions.
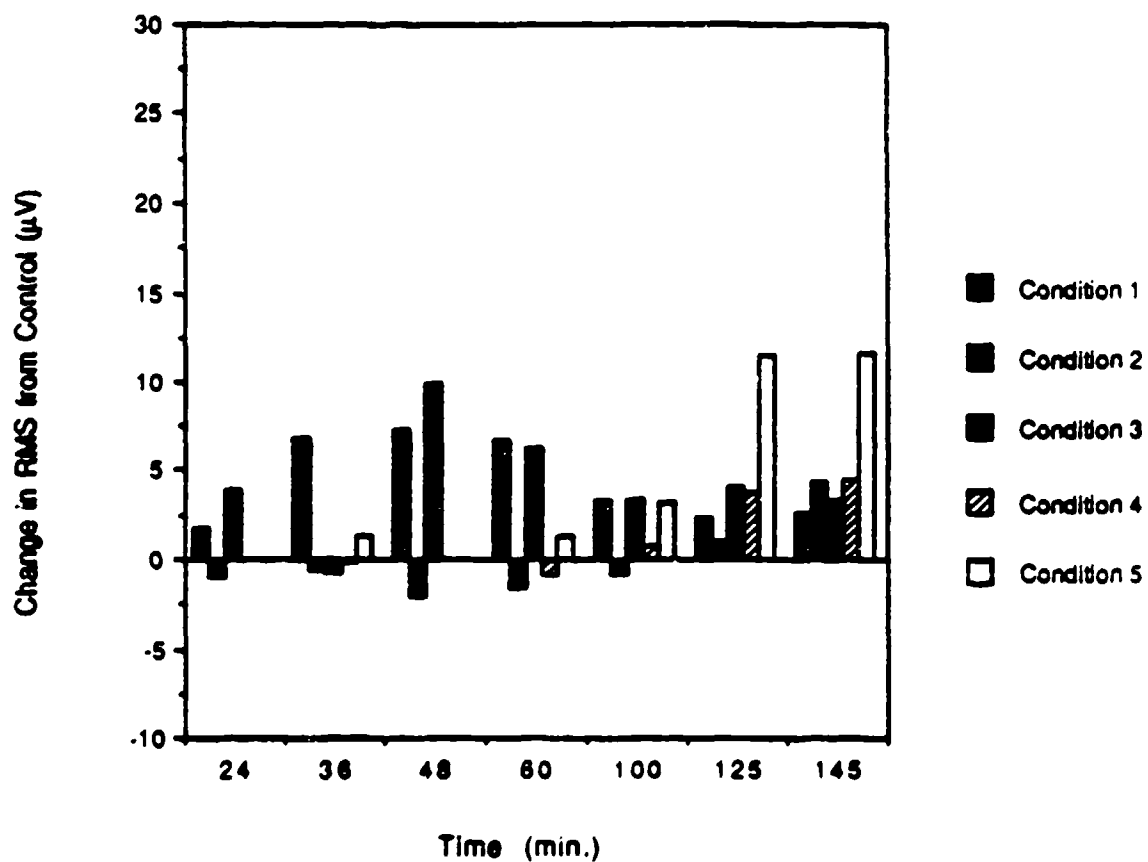
Figure 19. The change in RMS from control for the Soleus muscle as a function of time for the five conditions.
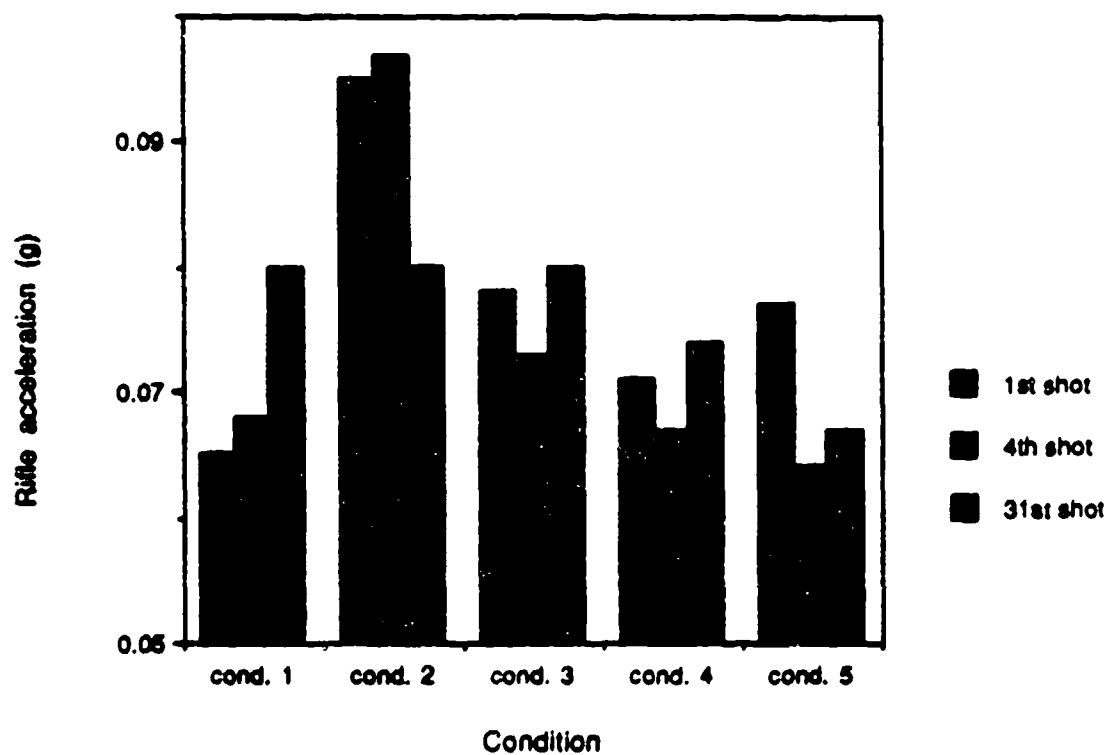
Figure 20. Acceleration of rifle during still target range test.
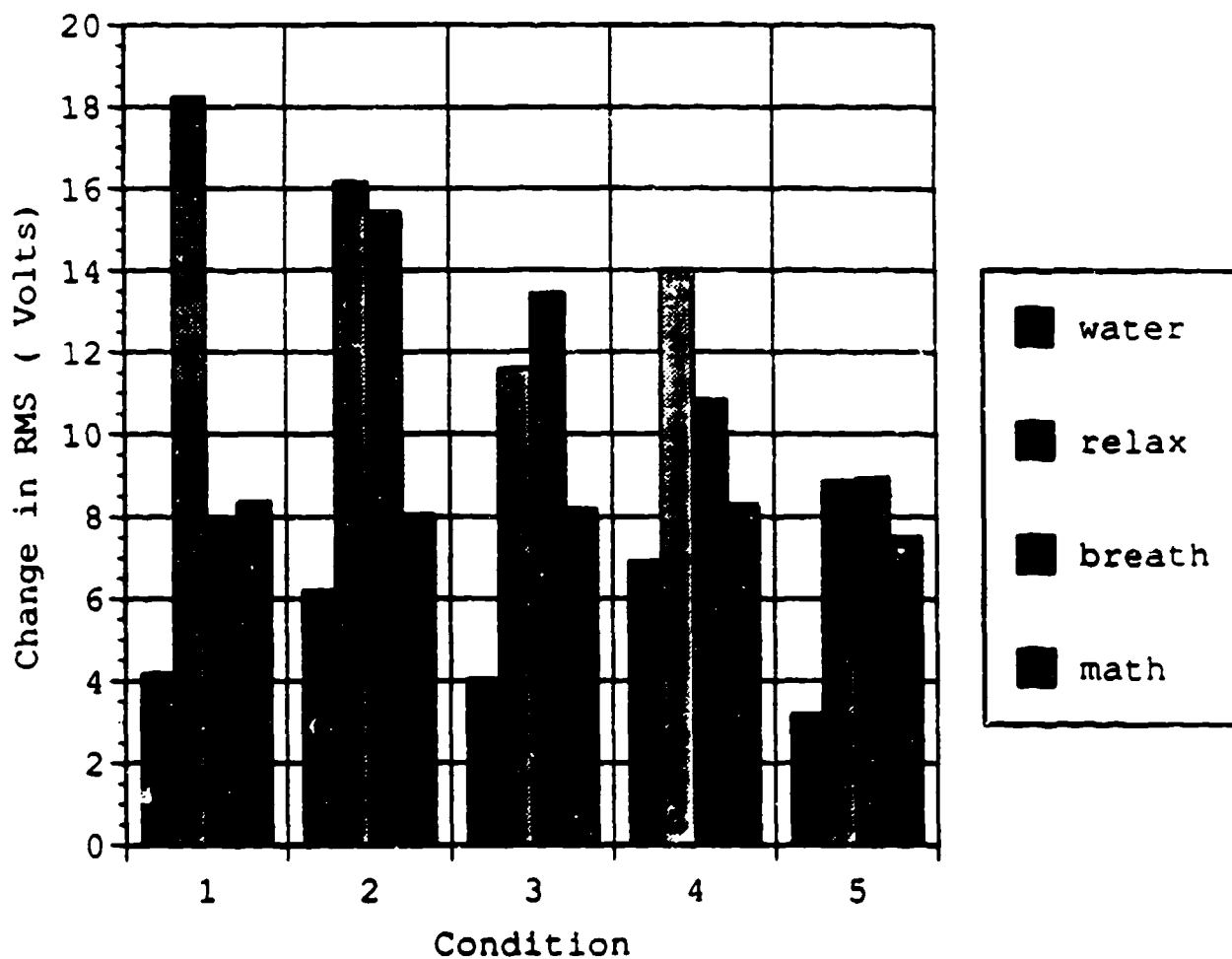
Figure 21. Change in RMS voltage determined from EMG activity prior to and after onset of shivering suppression method. The values presented here represent the mean of all seven muscle groups.

post-test measure (timing details are covered earlier in the Methods section).

The mean RMS value of all seven muscle groups, both control and post-maneuver, was computed for each subject in each condition and for each suppression maneuver. The control RMS value was subtracted from the post-maneuver RMS value to obtain the change in RMS induced by the suppression maneuver.

The data for the mean of all seven muscles is presented in Figure 21. Note that in this presentation, the larger the bar value, the better the shiver suppression. In all conditions, the warm water ingestion was the least effective means of shiver suppression and statistical analysis showed that there was no significant difference between the pre and post shiver RMS values for this suppression maneuver. On the other hand, with relaxation, mental arithmetic and breath holding there was a significant difference (ANOVA p<0.05) between the shiver RMS values before and after the suppression maneuver.

The shiver suppression results were analyzed for each individual muscle group across conditions as well (ANOVA). The data is summarized in Table 1. In Table 1, for each muscle and condition there is a 4x4 matrix: any nonzero entry indicates a shiver suppression technique that resulted in statistically significant (p<0.05) suppression of shivering in that muscle group and condition. These are abbreviated as follows: R = relaxation , M = mathematics, B = breath holding and W = warm water ingestion. The tabulated p values are included in the Appendix, Table 18. Of the 140 possible combinations of shivering suppression, muscle group and condition, there were 38 combinations that demonstrated a significant suppression of the shivering. Warm water ingestion produced no significant decrease in shivering in any muscle group or condition. Relaxation was responsible for significant suppression in 15 cases, mathematics 13 cases, and breath holding 10 cases. Most of the successful shiver suppressions occurred in the trapezius, pectoralis major and triceps muscles (30 significant suppressions). There was also somewhat less observed shiver suppression in those conditions that had a exercise component (conditions 4 and 5).

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TABLE 1

The effectiveness of shivering suppression techniques on different muscle groups and under the five conditions.

	Cond-1	Cond-2	Cond-3	Cond-4	Cond-5
Trapesius	R B	R B	O O	R B	R O
	O O	O O	O O	O O	O O
Pectoralis	R O	R B	R O	R O	R B
	M O	M O	M O	M O	M O
Biceps	O O	R O	R O	O O	O O
	O O	O O	O O	O O	O O
Triceps	R B	O O	R B	R B	O O
	M O	M O	M O	M O	M O
Rectus Femoris	O O	R B	O B	O O	O O
	M O	O O	M O	O O	O O
Biceps femoris	O O	O O	O O	O O	O O
	O O	O O	M O	O O	O O
Soleus	O O	O O	O O	O O	O O
	O O	O O	O O	O O	O O

If in the 4x4 matrix under any given condition and muscle group a letter other than O appears it indicates that the suppression technique (see abreviations below) significantly suppressed the shivering ($p < 0.05$).

R = Relaxation, B = breath holding, M = Mathematics, and W = warm water ingestion

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Cardiovascular and Respiratory Responses

The electrocardiogram was monitored throughout the experiment as part of the human subject safety protocol. No abnormal rhythms were observed during any of the experiments. The systolic and diastolic blood pressures were monitored during the first hour of the experiment in order to coincide with the exercise portion of the condition 4 and 5 protocols. No systolic or diastolic blood pressures (under conditions of rest or exercise) were observed that would have exceeded the acceptable limits set for the stress testing protocol (see methods) used initially in screening the subjects for participation in the program.

The cardiovascular data, heart rate and blood pressure (systolic and diastolic) for each of the five conditions is presented in Figures 22 through 26. This data was analyzed as percent change from control. During the first hour of cold exposure, there were minimal changes in heart rate and blood pressure. In conditions 4 and 5 the larger changes in heart rate and blood pressure reflect parameters measured during the exercise component of the sessions.

Maximum values for heart rate occurred at the beginning of the second hour, ranging from 20 to 30% increases. The only exception to this was in condition three, where the maximum heart rate occured somewhat later (see Figure 24). During the second hour, the heart rate fell progressively in all conditions (see Figures 22 through 26).

In conditions 4 and 5 the heart rate during the exercise bouts was the fixed criteria used to set the level of exercise. In both conditions the systolic blood pressure increased by approximately 40% and the diastolic pressure decreased slightly (see Figures 25 and 26). Between the first and second exercise period the heart rate remained elevated, but the systolic and diastolic blood pressures returned to pre-exercising levels.

The respiratory data is presented as percent change from control and is summarized in Figures 27 through 31. Respiratory changes, for the non-exercising portions of all conditions, show a similar pattern. Minute ventilation (VE) increases upon entering the cold chamber, and continues to rise slowly during the first hour of the test period. The observed increase in minute ventilation is due to an increase in tidal volume since the respiratory rate showed little or no change from the control level.

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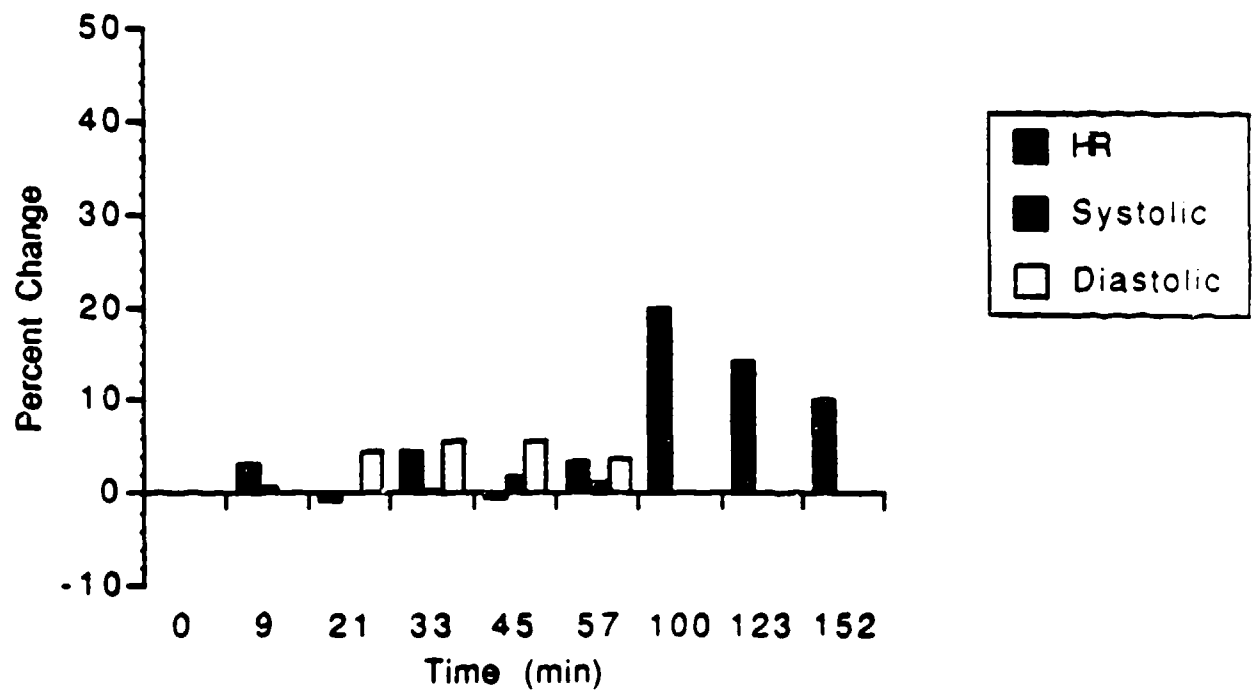
Figure 22. Condition 1 - Percent change from control of Heart Rate (HR), Systolic and Diastolic Blood Pressure.

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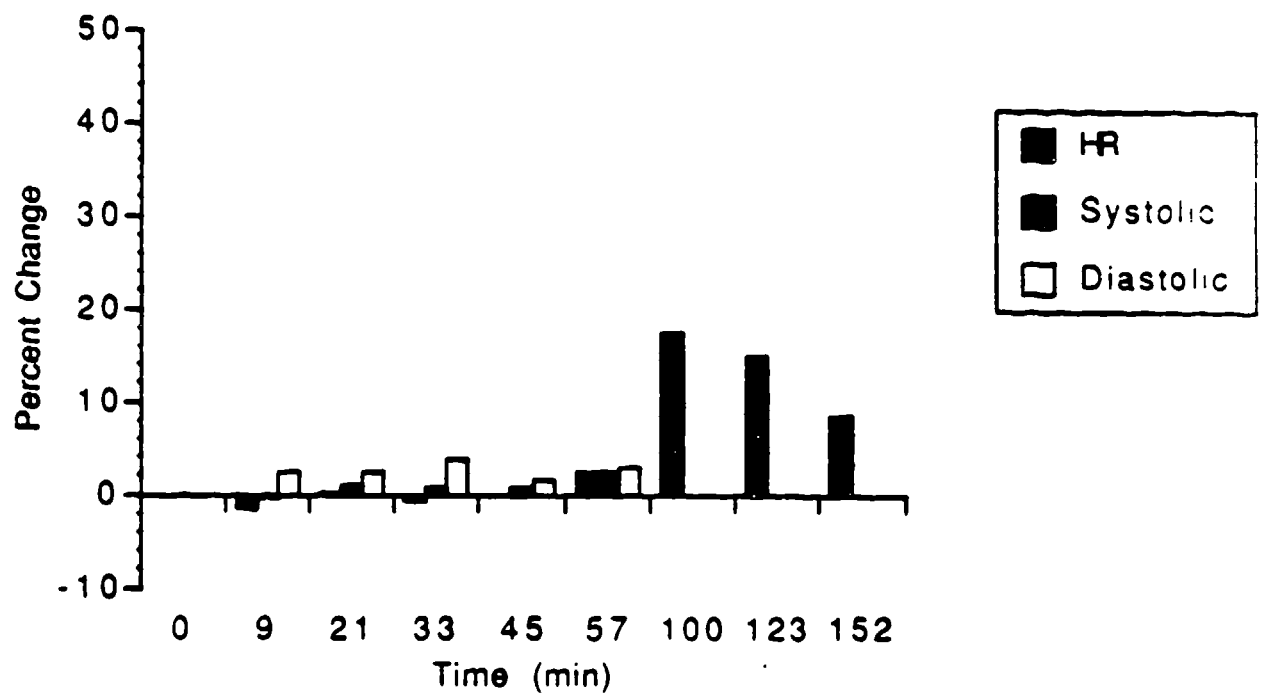
Figure 23. Condition 2 - Percent change from control of Heart Rate (HR), Systolic and Diastolic Blood Pressure.

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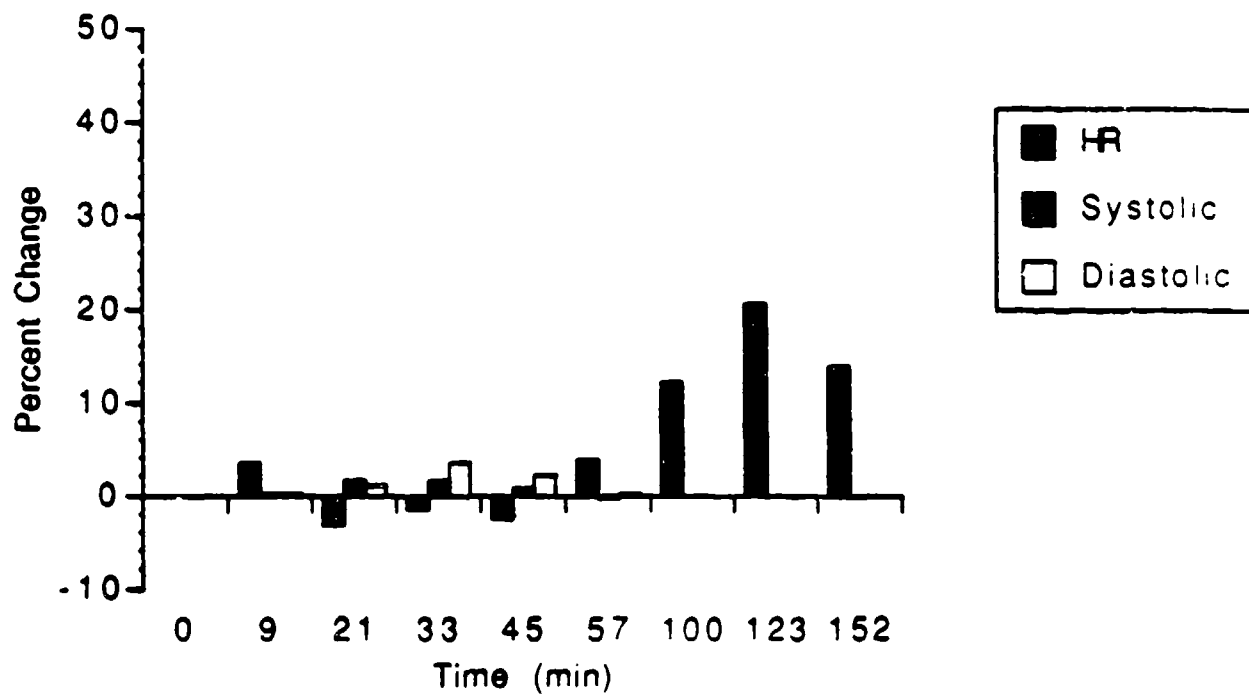
Figure 24. Condition 3 - Percent change from control of Heart Rate (HR), Systolic and Diastolic Blood Pressure.
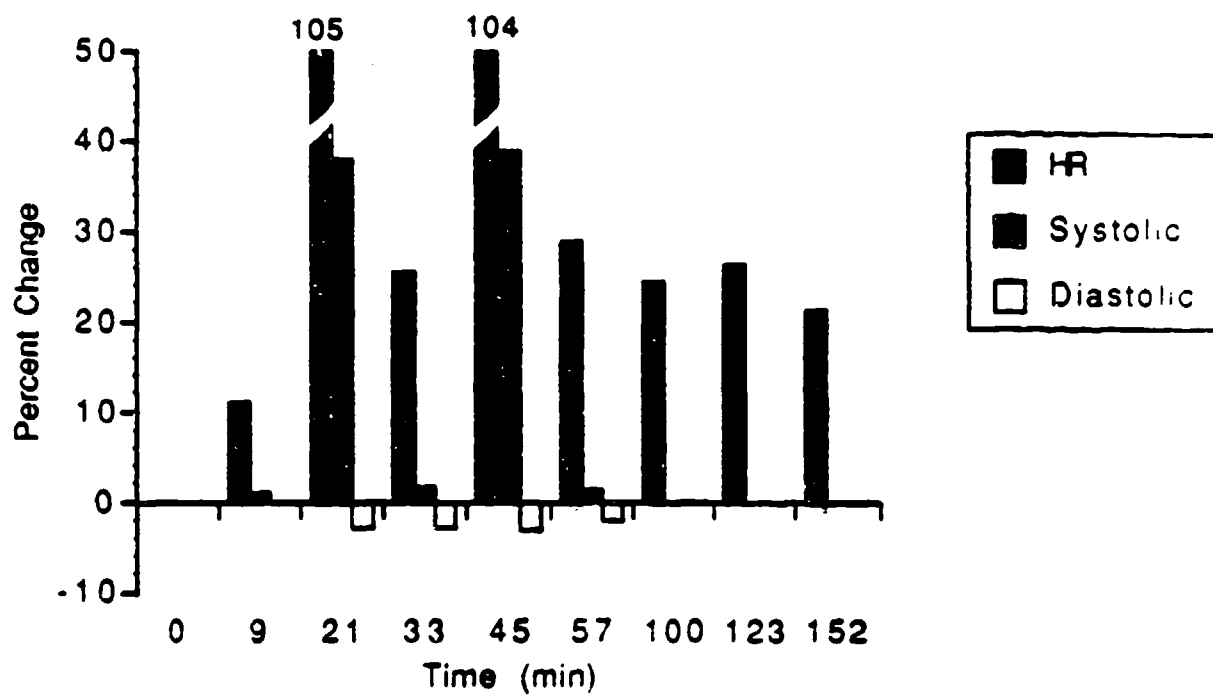
Figure 25. Condition 4 - Percent change from control of Heart Rate (HR), Systolic and Diastolic Blood Pressure.
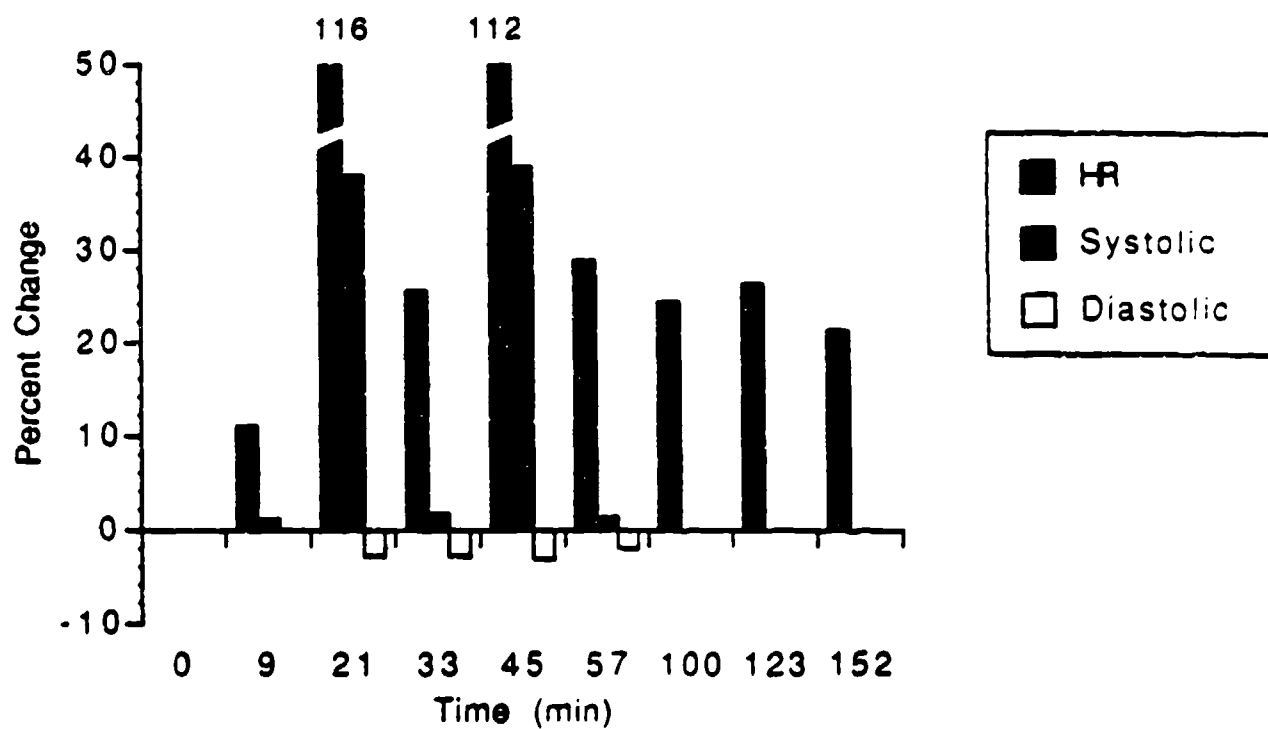
Figure 26. Condition 5 - Percent change from control of Heart Rate (HR), Systolic and Diastolic Pressure.
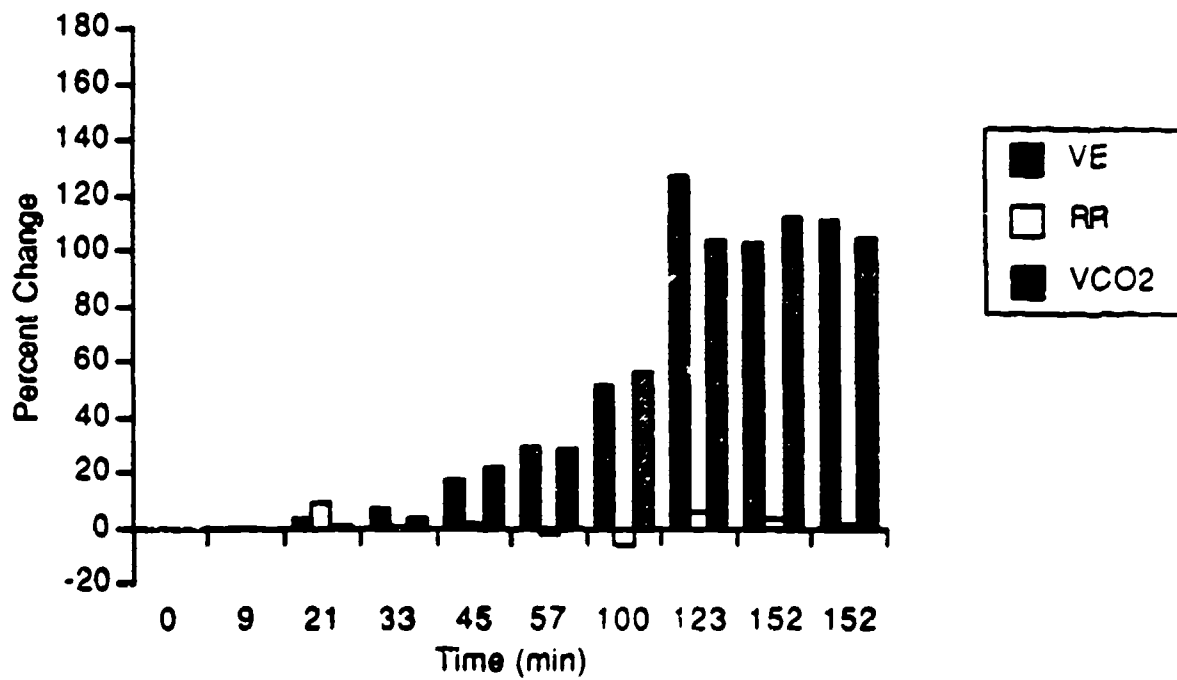
Figure 27. Condition 1 - Percent change from control of Minute Ventilation (VE), Respriatory rate (RR) and Carbon Dioxide production (VCO2).
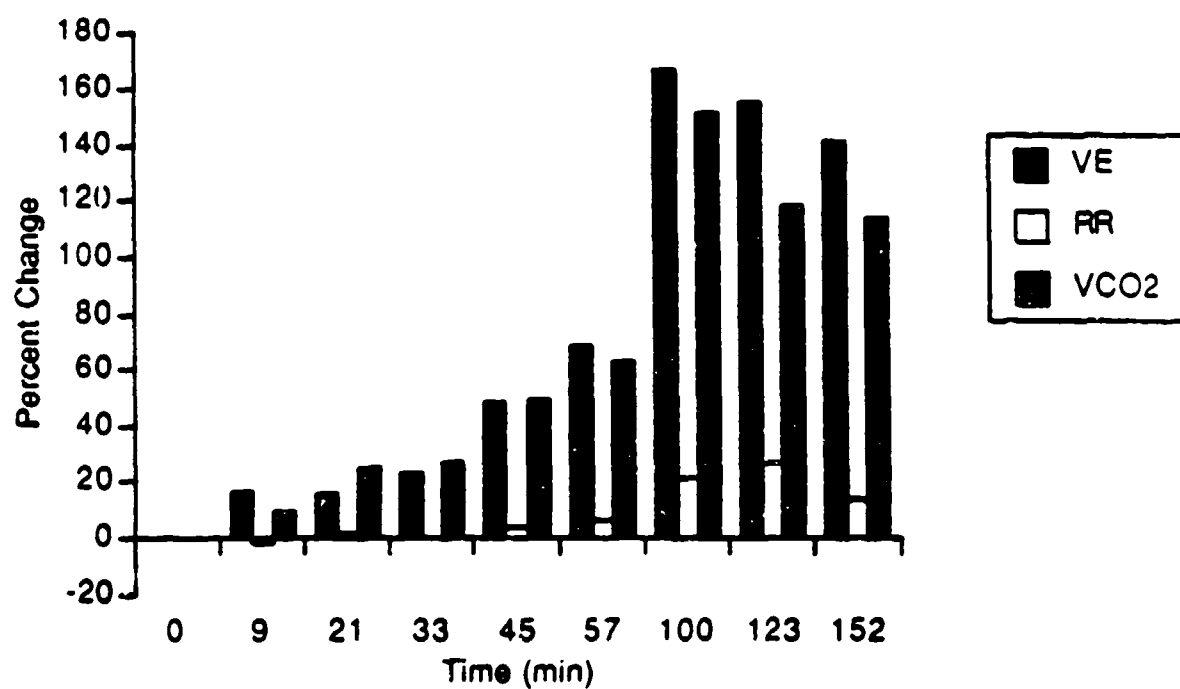
Figure 28. Condition 2 - Percent change from control of Minute Ventilation (VE), Respriatory rate (RR) and Carbon Dioxide production (VCO2).
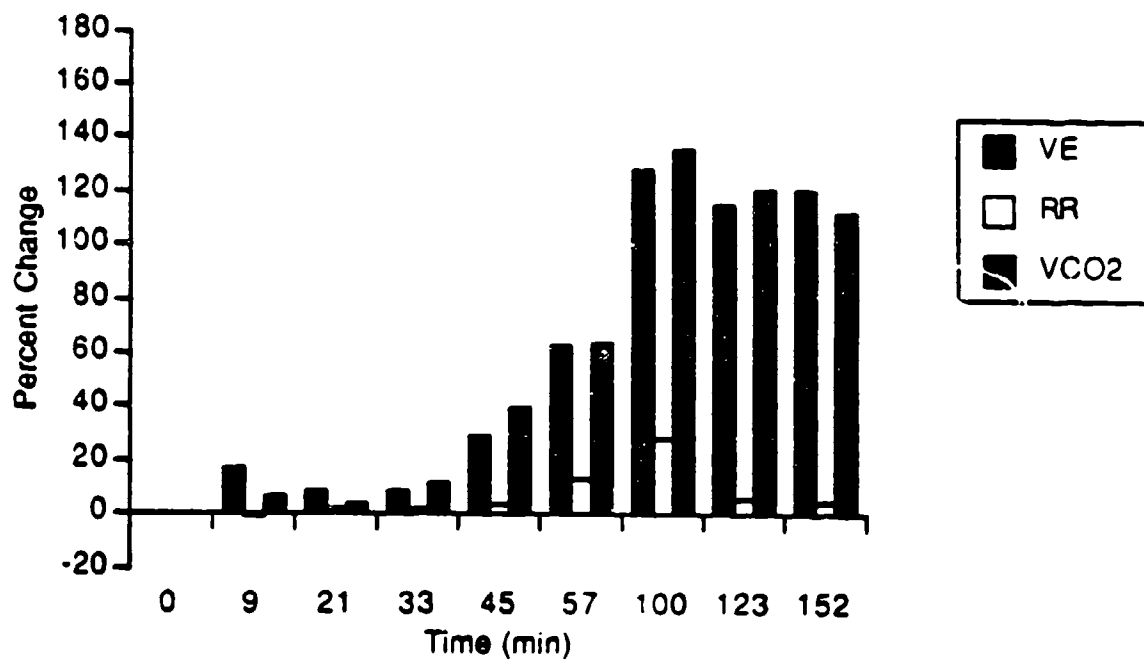
Figure 29. Condition 3 - Percent change from control of Minute Ventilation (VE), Respiratory rate (RR) and Carbon Dioxide production (VCO2).
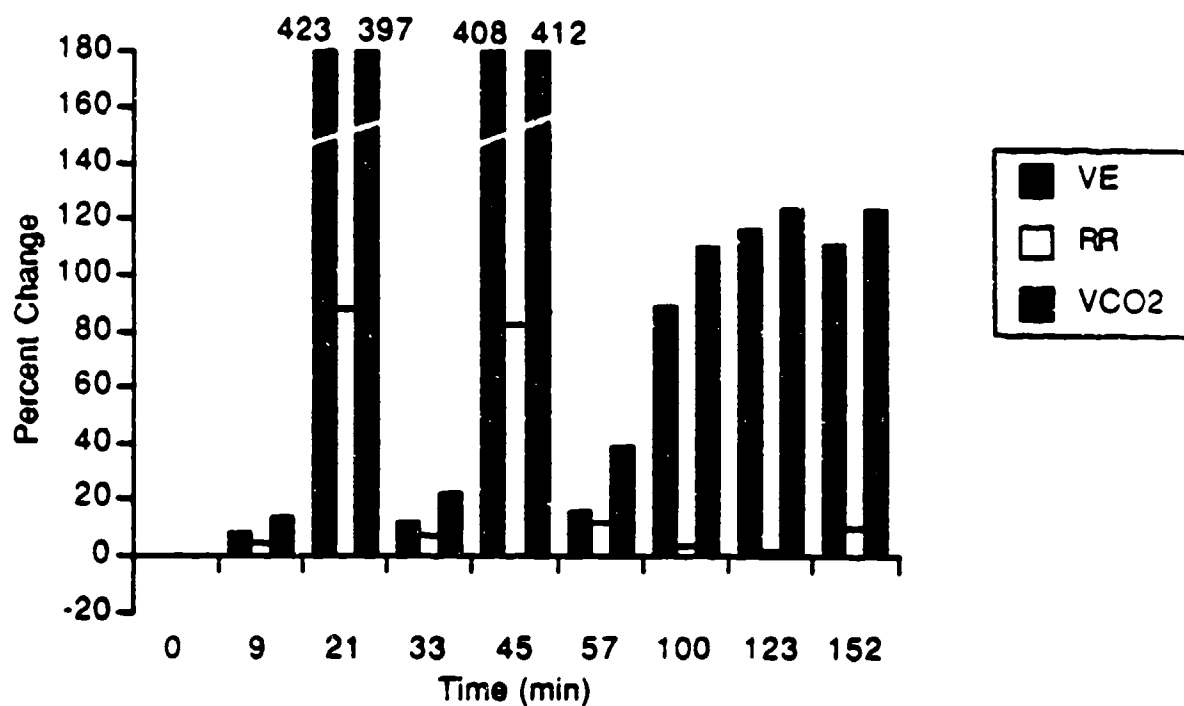
Figure 30. Condition 4 - Percent change from control of Minute Ventilation (VE), Respiratory rate (RR), and Carbon Dioxide production (VCO2).

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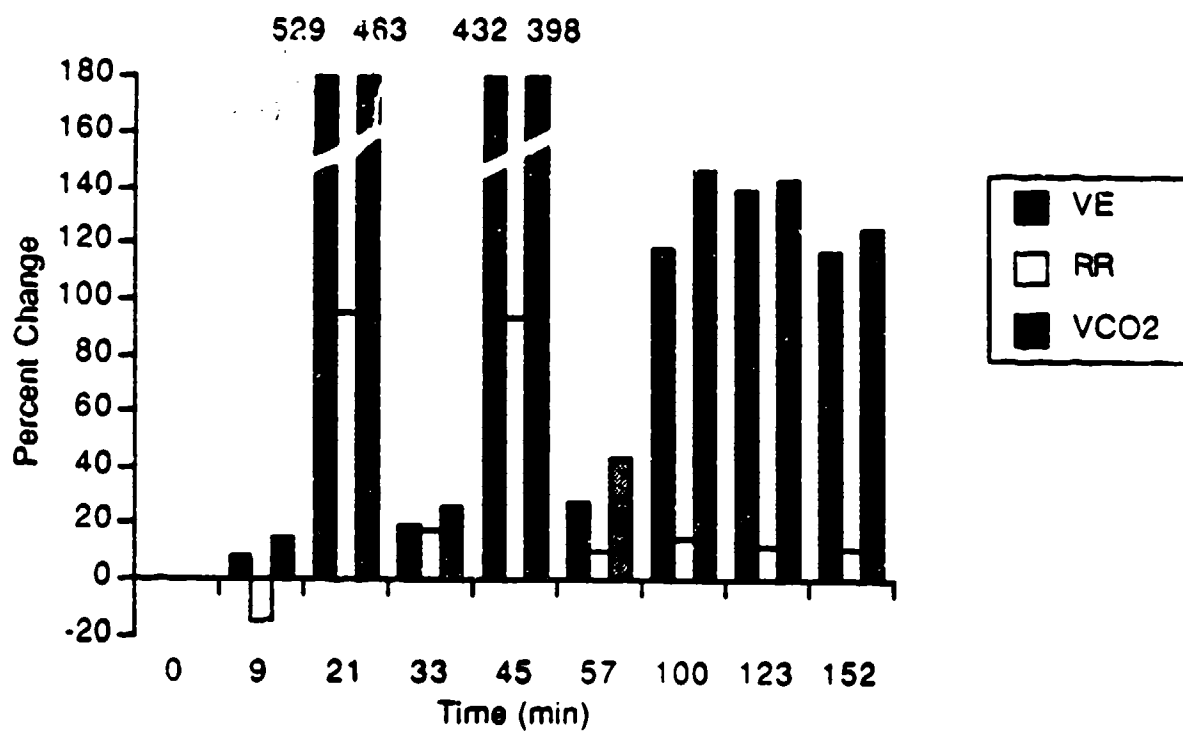
Figure 31. Condition 5 - Percent change from control of Minute Ventilation (VE), Respiratory rate (RR), and Carbon Dioxide production (VCO2)

There was a parallel slow rise in the carbon dioxide production. Early in the second hour there was a large and rapid increase in minute ventilation and carbon dioxide production with a small increase in respiratory rate.

During the exercise portion of conditions 4 and 5 there was a large increase in all respiratory parameters (see Figures 30 and 31). At the point midway between the two exercise periods the respiratory parameters returned to normal levels.

DISCUSSION

The overall objective of the present study was to evaluate the physiological and psychological responses of man following cold air exposure, with and without additional stressors. Data were gathered to address the following specific issues:

1. The time of shivering onset.
2. The pattern of shivering as it develops in the muscle groups sampled.
3. The relationship of shivering to skin and core temperature.
4. The effect of exercise on shivering and core temperature.
5. Cardiovascular and respiratory responses to cold exposure and their association with shivering.
6. The maintenance of cognitive functioning during cold exposure.
7. The maintenance of motor skills during cold exposure.
8. The evaluation of shiver suppression techniques.
9. Urinary catecholamine excretion as a measure of cold stress.
10. The effect of the additional stressors of sleep deprivation, lower extremity cold water immersion, and exercise on these abovementioned relationships.

The available data from these experiments suggest that sleep deprivation may contribute to an earlier onset of shivering, but that exercise (even relatively modest exercise) has a more powerful effect and significantly delays the onset of shivering and overrides any effect due to sleep deprivation. The onset of shivering was observed to occur earliest in condition 1, and it occurred at 24 minutes following cold air exposure in

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this condition. The intensity of shivering (as estimated by RMS values of monitored EMGs) rose during the first hour and declined during the second hour, but shivering did continue until the end of the testing period. It should be pointed out that condition 1 contained minimal physical activity when compared to all of the other conditions 2 through 5. In condition 2, even though the lower extremities were repeatedly immersed in cold water, shivering began somewhat later than in condition one, rising during the first hour with a large increase early in the second hour and sustained throughout the remainder of the experiment. The effect of sleep deprivation in condition 3 caused an earlier onset of shiver than in condition 2, with shiver well established at the beginning of the second hour of exposure. The addition of exercise in the first hour of the protocol in conditions 4 and 5 significantly delayed the onset of shivering until the second hour. In fact, at the 60 minute point the RMS values in the exercise protocols (conditions 4 and 5) are less than the control levels (see Figure 7, 11 & 12). By the end of the experiment, shivering in conditions 4 and 5 reached the same intensity as that in conditions 2 and 3, however (see Figure 7). The observed attenuation of shivering seen with exercise in these experiments coincided with core temperature increases and mean skin temperature increases following exercise, as well as changes in respiratory pattern and minute ventilation (see Figures1, 30 and 31).

The plots of mean skin temperature vs mean RMS are presented in figures 32 and 33. The pooled data for conditions 1, 2 and 3 (Figure 32) show little correlation (Pearson correlation coefficient = 0.46). On the other hand, in conditions 4 and 5 the correlation rises to 0.87. Care must be taken in interpreting this correlation, however, since the range in RMS values is relatively small and the values available are for the most part restricted to the two extremes. The plots of mean rectal temperature vs mean RMS are presented in Figures 34 and 35. The correlation for conditions 1, 2 and 3 between rectal temperatures and RMS was 0.83 and for conditions 4 and 5 was 0.87. The same reservations for the condition 4 and 5 correlation stated above apply here as well, of course.

Shivering requires an increase in energy expenditure and therefore an increase in oxygen delivery. This would necessitate an increase in minute ventilation. The correlation between minute ventilation and RMS values is
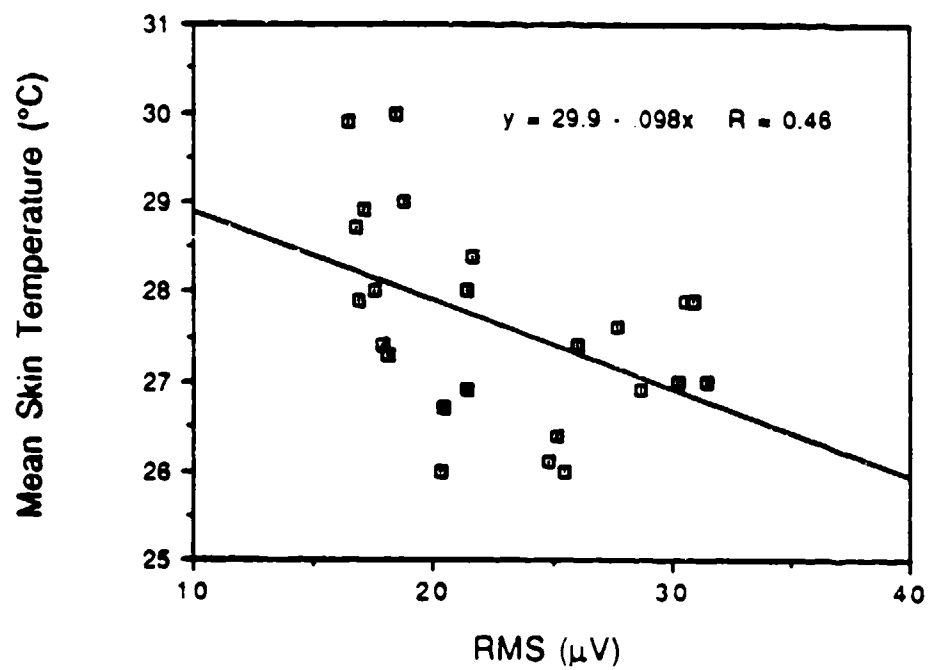
Figure 32. Relationship of mean skin temperature to mean RMS voltage of EMGs of all 7 muscles (data pooled for conditions 1-3).
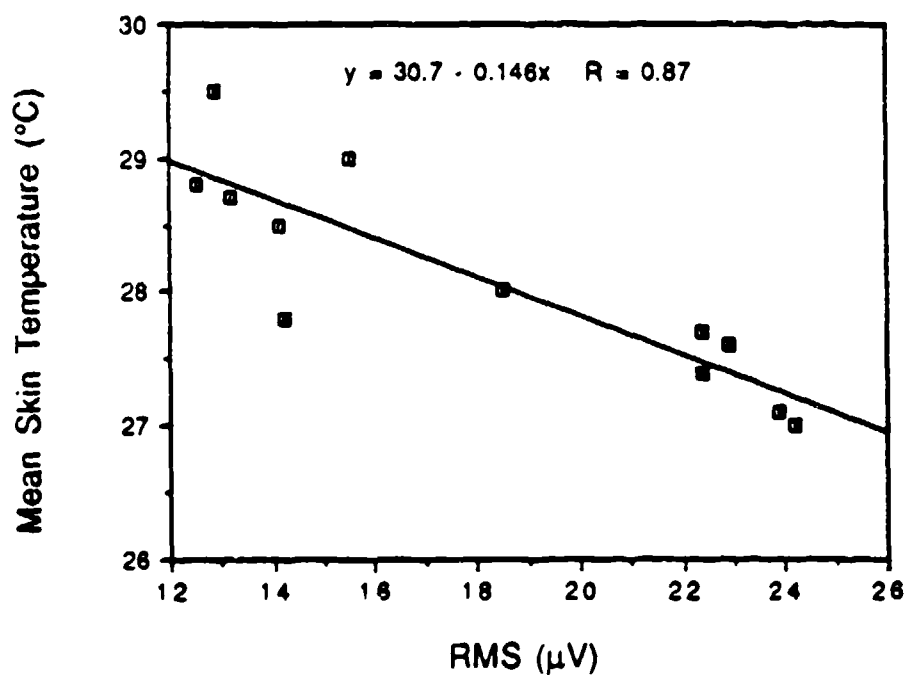
Figure 33. Relationship of mean skin temperature to mean RMS voltage of EMGs of all 7 muscles (data pooled from conditions 4 and 5).
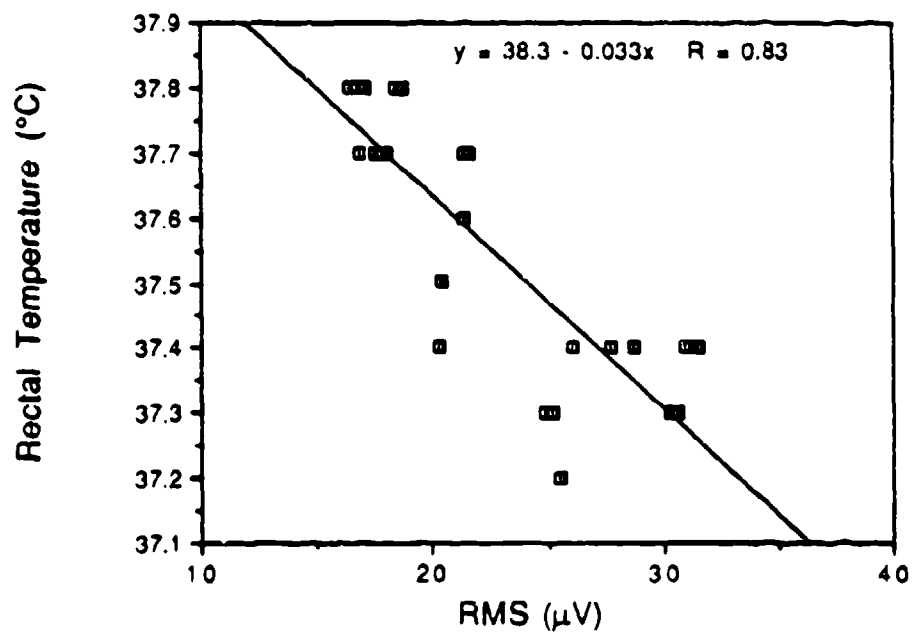
Figure 34. Relationship of rectal temperature to mean RMS
voltage of EMGs of all 7 muscles (data pooled from conditions 1-3).
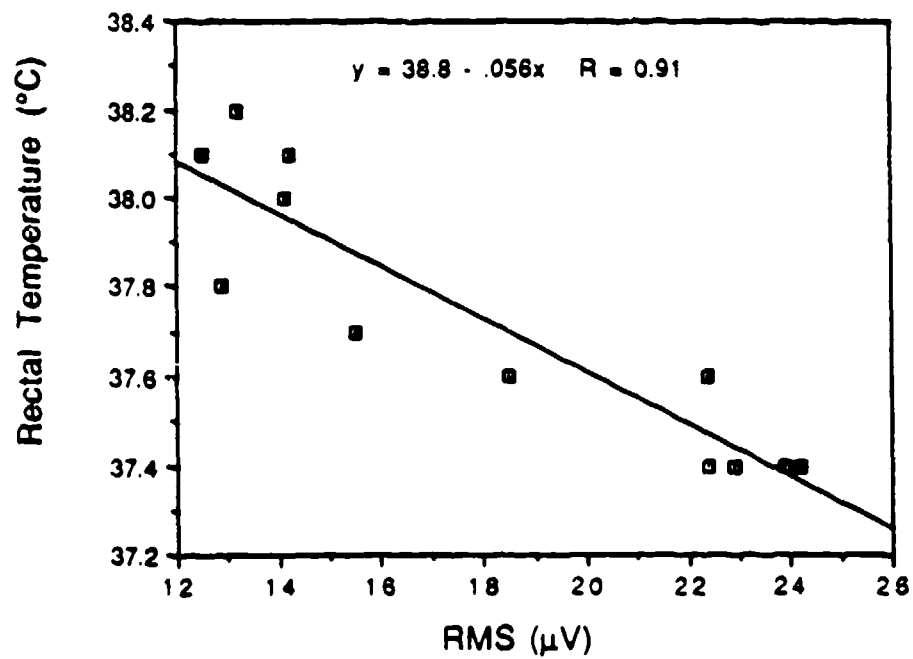
Figure 35. Relationship of rectal temperature to mean RMS
voltage of EMGs of all 7 muscles (data pooled from conditions 4-5).

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presented in Figures 36 and 37. The correlation in conditions 1, 2 and 3 was 0.92 and for 4 and 5 was 0.95.

Across all conditions, all muscle groups eventually showed shivering activity irrespective of the time of shiver onset. The trapezius demonstrated the greatest activity (highest RMS value) and in most conditions the pectoralis major was the second most prominent. The biceps femoris and the soleus showed the least activity. The addition of exercise in conditions 4 and 5 delayed the onset of shiver well into the second hour across all individual muscle groups (see Figures 11 & 12).

There have been numerous methods proposed to suppress shivering and the commonly accepted methods were investigated in a series of pilot studies prior to the present experiments. In these pilot experiments, no appreciable effect on shivering was found following the breathing of warm humidified air or when respiratory dead space was increased to increase the partial pressure of carbon dioxide in the inspired air. A commercially available face mask was observed to increase shivering, and no appreciable effect was found during or following isometric exercise. Decreased shivering (in order of effectiveness) was observed in pilot studies following breath holding, voluntary relaxation, mental concentration (reciting the alphabet backwards), and warm water ingestion. These four techniques that most successfully suppressed shiver were included in the full experimental protocol.

Warm water ingestion was the least effective shivering suppressor in the present experiments, and when analyzed on an individual muscle group there was no significant effect. Significant shivering suppression occurred following voluntary relaxation, mental arithmetic, and breathholding (in that order of effectiveness) and was most pronounced in the trapezius, pectoralis and triceps. The biceps femoris and soleus showed no suppression, with the exception of the biceps femoris following mental arithmetic (see Table 1). This may be due to the fact that these latter muscles showed a very weak shivering pattern even at the end of these experiment across all conditions; this weak signal, along with a relatively high variability, made demonstration of a significant suppression effect difficult.

In order to determine whether this level of cold exposure altered the subjects' cardiovascular response to exercise, the blood pressure response

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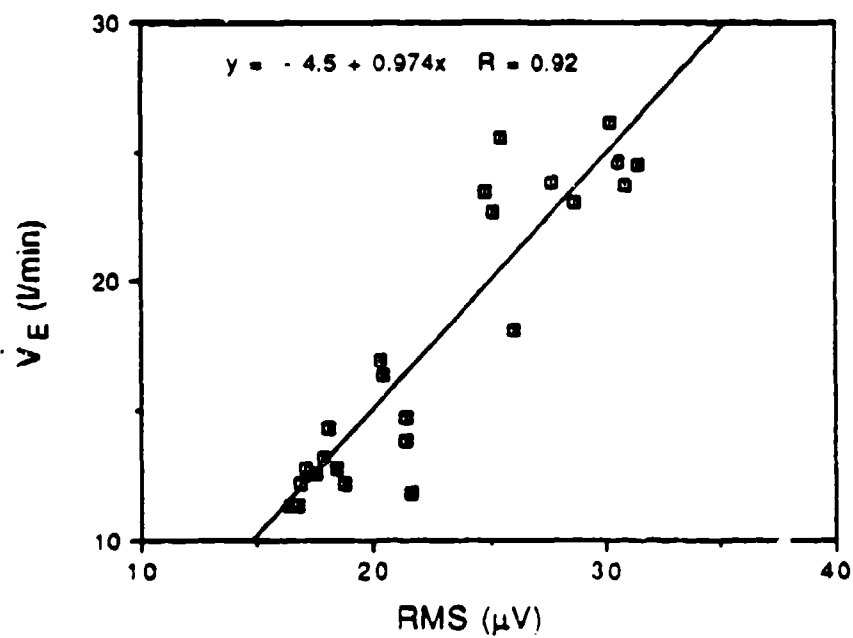
Figure 38. Relationship of minute ventilation ($\dot{V}_E$) to the mean RMS
voltage of EMGs of all 7 muscles (data pooled from conditions 1-3).
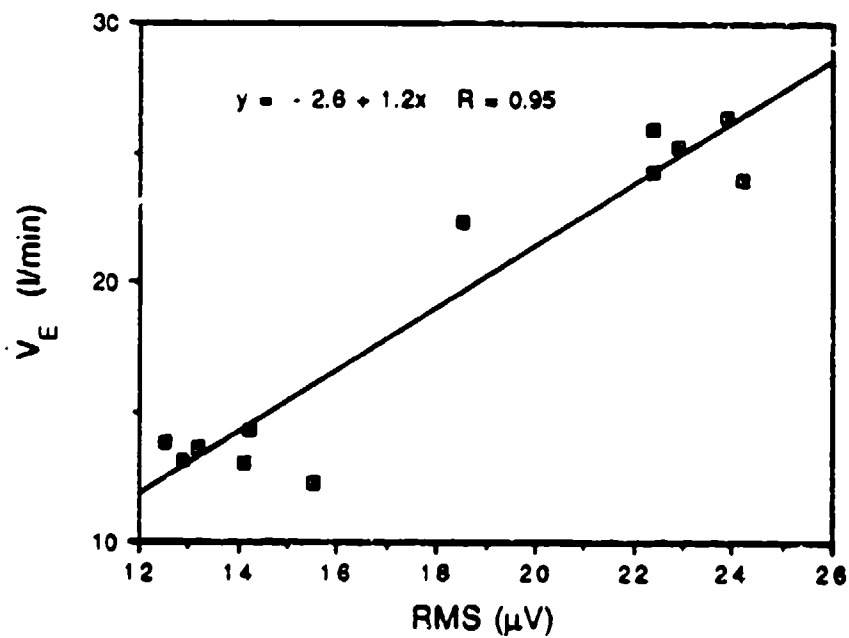
Figure 37. Relationship of minute ventilation ($\dot{V}_E$) to mean RMS voltage of EMGs of all 7 muscles (data pooled from conditons 4 and 5).

was compared to that observed in the stress test employed for screening. The average heart rate was determined for two exercise bouts during the cold exposure in conditions 4 and 5. The blood pressure associated with the matching heart rate (essentially identical exercise intensity) during the stress test was then compared to that observed in the cold. The heart rate values are included to illustrate the goodness of the attempted matching procedure. This data is summarized in Table 2.

Table 2

	Diastolic (mmHg)	Systolic (mmHg)	Heart rate (beats/minute)
Condition 4	67	176	152
Condition 5	65	170	150
Stress Test	64	164	150

In both conditions 4 and 5 the systolic blood pressure during exercise in the cold was greater than that observed when the subject was stress tested in a warm environment. Statistical analysis showed that only condition 4 vs stress test was different at the $p < 0.05$ level. The diastolic blood pressures were not different between the three conditions. The elevated systolic blood pressure under conditions of exercise in the cold most likely reflects increased peripheral vascular resistance, associated with heat conservation even in the face of a moderate work load.

The increase production of catecholamines is well documented to be associated with stressful situations. Although it would have been preferable to measure plasma catecholamines as a function of time throughout the experimental period, the complexity of the protocol was already too great to add this maneuver. As an alternative, urinary catecholamines were measured as a time-integrated estimate of catecholamine production during the cold exposure and a timed pre-exposure urine collection and analysis was used as the control.

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The amount of norepinephrine excreted was always significantly greater ($p<0.05$) during the experimental time when compared to the control value. There was a tendency for the norepinephrine excretion to be slightly higher in those conditions that contained an exercise component (conditions 4 and 5), but statistical analysis showed no significant differences between conditions (see Figure 3). A similar pattern surfaced in the epinephrine excretion, however statistical significance between control and test excretion occurred only in conditions 2, 4 and 5 (see Figure 2).

The catecholamine excretion indicates that the primary stressor affecting this parameter is the cold exposure. Exercise may have added to the catecholamine excretion but not sufficiently to make a significant difference, and sleep deprivation and lower limb cold water immersion appear to contribute negligibly.

In like manner, there was little evidence in the present experiments to suggest that the addition of sleep deprivation or lower limb cold water immersion had an appreciable effect on motor strength beyond that seen with cold air exposure only. Significant decrements in performance on cognitive tasks were not observed with the addition of sleep deprivation or cold water exposure either, nor was shooting performance affected to any appreciable extent. The available data from the present experiments suggests that 24 hour sleep deprivation has no demonstrable effect on at least some critical command and control task performance elements following cold air exposure, other than an observed earlier onset of shivering. Lower limb cold water immersion, although reported by subjects to increase their discomfort, likewise led to no appreciable decrements in performance measures nor did it contribute to an earlier onset or increased intensity of shivering. Exercise, even of brief duration, appeared to have a demonstrable effect on heat production, increasing core temperature, increasing minute ventilation, delaying the onset of shiver and possibly contributing to an decrease in target acquisition time during simulated 100 yard rifle range shooting.

Although the observed effect of exercise on shivering onset lends some support to the model of shivering as a peripheral oscillator, the mechanism of action is not clear. It is unclear what the relative contributions of increased core and skin temperatures following exercise

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are versus changes in respiratory parameters and cardiovascular measures, and this will be investigated further in Phase II experiments. The present experiments offered some support as well for a central oscillator component to shivering due to the very clear evidence of short-term volitional suppression of shiver, and the practical benefit of these shiver suppression techniques in combat relevant tasks will be investigated in Phase II experiments as well.

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APPENDIX I

Army Personal Data

Subj #	Height (cm)	Weight (kg)	Age Yrs	%BF Brozek	Test Span Days*	HR Control	HR*** @18%	Systolic BP (mmHg)	Diastolic BP (mmHg)	Mean BP (mmHg)	Initial Rectal Temp °C
1	175	78.2	22	19.95	28	78	145	150	80	103	37.8
2	189	77.7	24	12.84	28	64	174	130	66	87	37.78
3**	180	82.5	35	22.67	**	76	175	124	68	86	38.20**
4	178	70.9	25	9.79	26	76	170	132	64	86	37.96
5	143	64.5	30	15.88	28	90	172	128	70	89	37.38
6	183	71.4	23	6.14	44	44	155	116	64	81	37.64
7	183	80.9	27	20.92	27	68	174	118	68	84	37.74
8	175	85.9	27	24.36	54	60	140	120	70	86	37.68
9	183	80.9	28	16.65	101	66	170	116	64	81	37.28
10**	183	89.5	29	17.55	**	72	125	122	72	88	37.15
11	178	77.3	30	25.01	115	76	174	128	70	89	37.15**
12	175	98.6	22	22.97	35	80	165	128	74	92	37.66
13	180	71.4	24	17.69	35	76	170	124	70	88	37.84
14	183	87.7	31	15.1	39	60	125	122	70	87	37.16
15	178	78.2	22	18.64	29	76	175	116	70	85	37.78
Mean	177.73	79.71	26.60	17.74	45.31	70.80	160.60	124.93	69.33	87.47	37.60
SD	10.37	8.56	3.91	5.33	29.10	10.92	18.13	8.71	4.19	5.18	0.27
SEM	2.68	2.21	1.01	1.38	8.07	2.82	4.68	2.25	1.08	1.34	0.07

*Elapsed time from first to last test

**Subjects did not complete study - data not included in analysis

***Maximum HR reached at 18% grade during the screening stress test (tread mill speed 3 mph)

Cold Stress Subject Instruction Sheet

The following is a list of things we would like you to do before your arrival at the hypothermia laboratory.

1. No drug use 48 hours prior to any experiment.

2. No alcohol use 24 hours prior to any experiment.

3. No caffeine or tobacco use 12 hours prior to any experiment.

4. A normal nights sleep the night before each experiment. (unless you are schedule for a sleep depriation protocol. For the sleep deprivation studies, specific directions will be given.

5. Eat a light meal 2 hours prior to your arrival at the hypothermia laboratory.

6. Besides the clothing you will have on when you arrive, please bring an extra pair of cotton socks and a pair of gym/running shorts. All other clothing that you will wear during the experiments (pants, belt, shirt and boots) will be provided by us.

7. A pretest urine sample will be required. Empty your bladder completely about 1 hour prior to arriving at the hypothermia laboratory. Note and record the exact time and give that information to one of the investigators.

Table 1. Grip Strength (kg.)

CONDITION 1

Subject #	Pre test 1	Pre Test 2	Pre Mean	Test 1	Test 2	Test Mean	Pre minus Test	% change
1	30.00	25.00	27.50	28.00	24.50	26.25	1.25	4.55%
2	44.00	47.00	45.50	38.00	42.50	39.25	6.25	13.74%
4	44.00	48.50	46.25	36.00	36.50	36.25	10.00	21.62%
5	42.50	44.00	43.25	33.00	36.00	34.50	8.75	20.23%
6	50.50	53.50	52.00	50.00	49.50	49.75	2.25	4.33%
7	48.50	46.50	47.50	44.00	44.00	44.00	3.50	7.37%
8	62.00	63.50	62.75	62.00	59.00	60.50	2.25	3.59%
9	74.50	75.00	74.75	67.00	60.00	63.50	11.25	15.05%
11	42.00	49.50	45.75	49.00	48.00	48.50	-2.75	-6.01%
12	51.50	53.00	52.25	44.00	45.00	44.50	7.75	14.83%
13	60.00	61.50	60.75	52.00	55.00	53.50	7.25	11.93%
14	50.50	54.00	52.25	46.00	55.50	50.75	1.50	2.87%
15	43.50	44.00	43.75	37.00	37.00	37.00	6.75	15.43%
Means	49.50	51.15	50.33	44.92	45.58	45.25	5.08	9.96%
s.d.			11.38			10.64	4.07	7.92
s.e.m.			3.16			2.95	1.13	2.20

CONDITION 2

Subject #	Pre test 1	Pre Test 2	Pre Mean	Test 1	Test 2	Test Mean	Pre minus Test	% change
1	39.00	37.50	38.25	36.50	35.00	35.75	2.50	6.54%
2	60.00	61.00	60.50	49.00	55.00	52.00	8.50	14.05%
4	55.50	57.50	56.50	53.50	53.50	53.50	3.00	5.31%
5	50.50	48.00	49.25	47.50	48.50	48.00	1.25	2.54%
6	59.50	56.00	57.75	58.00	58.00	58.00	-0.25	-0.43%
7	44.00	45.00	44.50	45.50	43.00	44.25	0.25	0.56%
8	63.00	58.00	60.50	40.00	40.00	40.00	20.50	33.88%
9	69.50	67.00	68.25	58.00	58.50	58.25	10.00	14.65%
11	41.00	40.00	40.50	38.00	38.00	37.00	3.50	8.64%
12	48.00	48.00	48.00	45.50	41.50	43.50	4.50	9.38%
13	62.00	65.00	63.50	59.00	59.00	59.00	4.50	7.09%
14	53.00	52.50	52.75	47.00	53.00	50.00	2.75	5.21%
15	50.50	49.00	49.75	44.50	44.00	44.25	5.50	11.06%
Means	53.50	52.65	53.08	47.85	48.08	47.96	5.12	9.11%
s.d.			9.06			7.96	5.48	8.76
s.e.m.			2.51			2.21	1.52	2.43

Table 1. (cont) Grip Strength (kg.)

CONDITION 3

Subject #	Pre test 1	Pre Test 2	Pre Mean	Test 1	Test 2	Test Mean	Pre minus Test	% change
1	45.00	50.00	47.50	44.00	48.00	46.00	1.50	3.16%
2	50.00	55.50	52.75	19.50	24.50	22.00	30.75	58.29%
4	44.50	47.00	45.75	37.70	38.00	37.85	7.90	17.27%
5	47.00	47.50	47.25	47.00	43.00	45.00	2.25	4.76%
6	60.00	56.00	58.00	60.00	45.00	52.50	5.50	9.48%
7	49.00	51.00	50.00	44.00	50.00	47.00	3.00	6.00%
8	80.00	60.00	60.00	60.00	61.00	60.50	-0.50	-0.83%
9	69.50	75.00	72.25	48.00	60.00	54.00	18.25	25.26%
11	53.50	53.50	53.50	51.00	50.00	50.50	3.00	5.61%
12	47.00	50.00	48.50	46.00	46.50	46.25	2.25	4.64%
13	59.00	59.00	59.00	58.00	60.00	59.00	0.00	0.00%
14	51.00	52.00	51.50	40.00	45.00	42.50	9.00	17.48%
15	56.50	47.50	52.00	45.00	45.00	45.00	7.00	13.46%
Means	53.23	54.15	53.69	46.17	47.38	46.78	6.92	12.66%
s.d.			7.21			9.81	8.71	15.68
s.e.m.			2.00			2.72	2.42	4.35

CONDITION 4

Subject #	Pre test 1	Pre Test 2	Pre Mean	Test 1	Test 2	Test Mean	Pre minus Test	% change
1	38.50	35.00	36.75	41.00	36.00	38.50	-1.75	-4.76%
2	58.00	58.00	58.00	45.00	43.50	44.25	13.75	23.71%
4	52.00	46.00	49.00	46.50	43.50	45.00	4.00	8.16%
5	42.50	69.00	55.75	30.50	34.00	32.25	23.50	42.15%
6	57.00	60.50	58.75	53.00	54.00	53.50	5.25	8.94%
7	32.00	30.00	31.30	29.00	26.50	27.75	3.25	10.46%
8	62.50	57.50	60.00	51.00	53.50	52.25	7.75	12.92%
9	77.50	78.50	78.00	63.50	63.00	63.25	14.75	18.91%
11	47.00	49.00	48.00	44.00	43.00	43.50	4.50	9.38%
12	48.50	41.00	44.75	35.50	36.00	35.75	9.00	20.11%
13	63.50	59.00	61.25	63.00	63.00	63.00	-1.75	-2.86%
14	41.50	49.50	45.50	56.50	48.50	52.50	-7.00	-15.38%
15	53.00	52.50	52.75	47.00	52.00	49.50	3.25	6.16%
Means	51.81	52.73	52.27	46.58	45.88	46.23	6.04	10.61%
s.d.			11.95			10.91	7.99	14.30
s.e.m.			3.31			3.03	2.22	3.97

Table 1. (cont) Grip Strength (kg.)

CONDITION 5

Subject #	Pre test 1	Pre Test 2	Pre Mean	Test 1	Test 2	Test Mean	Pre minus Test	% change
1	43.00	46.00	44.50	44.00	39.50	41.75	2.75	6.18%
2	59.50	62.50	61.00	56.00	54.50	55.25	5.75	9.43%
4	59.50	57.00	58.25	58.50	54.00	56.25	2.00	3.43%
5	47.00	52.50	49.75	47.50	46.00	46.75	3.00	6.03%
6	65.50	62.50	64.00	65.00	60.00	62.50	1.50	2.34%
7	39.00	38.00	38.50	26.00	26.00	26.00	12.50	32.47%
8	50.00	54.00	52.00	41.00	43.50	42.25	9.75	18.75%
9	76.00	75.00	75.50	63.00	73.00	68.00	7.50	9.93%
11	42.00	46.00	44.00	41.00	45.00	43.00	1.00	2.27%
12	49.00	47.00	48.00	33.00	38.50	35.75	12.25	25.52%
13	58.00	59.50	58.75	55.00	56.00	55.50	3.25	5.53%
14	45.00	50.00	47.50	51.00	51.00	51.00	-3.50	-7.37%
15	45.00	44.50	44.75	52.50	53.00	52.75	-8.00	-17.88%
Mean	52.19	53.42	52.81	48.73	49.23	48.98	3.83	7.43%
s.d.			10.21			11.32	5.85	13.00
s.e.m.			2.83			3.14	1.62	3.61

Variable Descriptions: 'Pre test' values (Kg) are those obtained prior to cold exposure.
'Test' values (Kg) are those obtained after 90 minutes of cold exposure.

Table 2.

CCAB Following Directions

CONDITION 1 (cold air)

Sub #	Score	Total Time	Mean Time
1	1473	82.5	5.16
2	1267	93.4	5.71
4	1219	94.8	6.37
5	1890	72.4	4.73
6	1384	88.7	5.8
7	•	•	•
8	1289	93.9	5.62
9	1484	89.6	7.45
11	1716	68.9	5.4
12	•	•	•
13	1232	98.7	7.26
14	1409	88.3	6.44
15	1441	84.9	6.24
Means	1418.55	86.92	6.02

CONDITION 2 (cold water)

Sub #	Score	Total Time	Mean Time
1	1348	92.4	5.32
2	1470	86.4	6.34
4	1586	67.8	4.33
5	1920	53.1	3.67
6	1800	59	4.54
7	1432	88.1	7.5
8	•	•	•
9	1613	76.4	6.29
11	1356	90.2	6.79
12	•	•	•
13	1806	65.8	5.11
14	1295	98.5	6.02
15	•	•	•
means	1562.60	77.77	5.59

CONDITION 3 (cold water fatigued)

Sub #	Score	Total Time	Mean Time
1	1894	56.2	4.11
2	1009	120	6.44
4	1531	74.3	5.5
5	1685	67.7	4.93
6	•	•	•
7	1470	97.1	7.56
8	1238	98	6.64
9	1421	90	6.7
11	1645	72.4	5.62
12	1558	73.6	4.63
13	1659	70.9	5.25
14	964	120	7.53
15	1461	82.3	6.29
means	1461.25	85.21	5.93

CONDITION 4 (cold water exercise)

Sub #	Score	Total Time	Mean Time
1	1262	99	2.62
2	1021	120	6.09
4	1611	86	5.75
5	1720	69.9	5.05
6	•	•	•
7	1235	97.9	6.81
8	1435	89	5.74
9	1267	97.1	7.22
11	1850	57.8	4.48
12	1121	116.1	6.23
13	1860	57	4.5
14	1210	100.1	6.33
15	1366	91.9	6.03
means	1413.17	90.16	5.57

Note: Asterisks (•) indicate missing data due to computer malfunction.

CONDITION 5 (cold water exercise fatigued)

Sub #	Score	Total Time	Mean Time
1	1499	75.6	3.46
2	1360	102.7	6.16
4	•	•	•
5	1662	74	5.03
6	1895	52.2	3.89
7	1200	106.4	6.74
8	1168	101.4	6.33
9	1631	76.9	5.99
11	1297	106.6	6.39
12	1520	79.7	5.39
13	1195	109.9	6.23
14	956	120	9.09
15	1251	95.8	3.32
means	1386.17	91.77	5.67

Table 3.

CCAB Tower Puzzle

CONDITION 1 (cold air)

Sub #	Score	Total Time	Min/Act moves	% Done	Errors	Reversals	Mean Time
1	1974	18.1	0.97	100.00%	2	1	3.86
2	965	39.5	0.85	69.00%	1	2	5.6
4	657	47.1	1.2	33.30%	8	8	5.86
5	1311	31	0.96	90.50%	3	2	3.55
6	1732	26.2	0.94	100.00%	0	2	3.53
7	•	•	•	•	•	•	•
8	1342	35.5	1.06	87.20%	3	2	9.3
9	1932	23.7	1	100.00%	0	0	5.15
11	1050	36.3	0.94	66.67%	0	2	5.49
12	•	•	•	•	•	•	•
13	1189	35.9	1.08	66.66%	2	3	8.59
14	1032	39.9	1.06	66.67%	3	1	4.82
15	1211	36.4	1.44	66.66%	0	1	10.2
means	1308.64	33.60	1.05	76.97%	2.00	2.18	6.00

CONDITION 2 (cold water)

Sub #	Score	Total Time	Min/Act moves	% Done	Errors	Reversals	Mean Time
1	1862	26	1	100.00%	0	0	4.81
2	1117	39.1	0.79	97.60%	0	1	6.63
4	1729	25.4	0.89	100.00%	1	1	4.08
5	1319	28.3	1.44	0.69	5	2	3.94
6	1613	26.7	0.89	100.00%	1	4	3.64
7	1186	37.9	1.02	66.66%	0	3	6.3
8	•	•	•	•	•	•	•
9	1721	28.1	0.98	100.00%	0	0	6.56
11	1815	23.9	1	100.00%	0	0	4.06
12	•	•	•	•	•	•	•
13	1225	32.6	0.92	66.67%	2	3	4.69
14	1034	38.5	1.03	69.00%	1	4	4.94
15	•	•	•	•	•	•	•
means	1462.10	30.65	1.00	86.89%	1.00	1.80	4.97

Note: Asterisks (*) indicate missing data due to computer malfunction

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Table 3 (cont.).

CCAB Tower Puzzle

CONDITION 3 (cold water fatigued)

Sub #	Score	Total Time	Min/Act moves	% Done	Errors	Reversals	Mean Time
1	1692	23.1	0.9	100.00%	3	3	2.91
2	576	50.8	0.91	66.70%	4	1	6.76
4	1123	39.7	0.83	100.00%	2	2	6.37
5	1881	17.2	0.96	100.00%	0	1	4.16
6	•	•	•	•	•	•	•
7	1306	36.4	1.08	77.80%	0	5	6.87
8	1057	37	1.02	66.67%	3	6	8.04
9	461	52	1.76	40.00%	0	4	14.21
11	1751	26.2	1	100.00%	1	0	6.17
12	1248	33.4	0.81	100.00%	0	4	3.62
13	663	43.5	1.32	33.33%	3	7	6.08
14	685	43.8	0.75	73.80%	1	7	5.26
15	916	42.1	1.35	69.00%	0	4	12.14
means	1113.25	37.10	1.06	77.27%	1.42	3.67	6.88

CONDITION 4 (cold water exercise)

Sub #	Score	Total Time	Min/Act moves	% Done	Errors	Reversals	Mean Time
1	1048	35.9	0.89	66.70%	5	6	3.15
2	949	41	0.81	66.70%	1	1	6.39
4	1057	41.9	0.81	86.10%	0	4	7.83
5	946	42.9	0.91	66.06%	5	6	3.9
6	•	•	•	•	•	•	•
7	1145	38.8	1	71.10%	0	1	4.6
8	1292	32.6	1.39	66.67%	3	3	6.59
9	662	44.1	1.01	66.67%	2	5	6.83
11	1272	34.7	0.94	92.30%	2	3	4.87
12	882	40.1	0.8	82.10%	0	4	4.09
13	800	43.4	0.83	67.80%	2	4	6.41
14	1242	34.1	1.33	71.40%	3	2	5.71
15	1430	32.2	0.98	90.50%	0	2	8
means	1060.42	38.48	0.98	74.56%	1.92	3.42	5.70

Note: Asterisks (°) indicate missing data due to computer malfunction

Table 3 (cont.).

CCAB Tower Puzzle

CONDITION 5 (cold water exercise fatigued)

Sub #	Score	Total Time	Min/Act moves	% Done	Errors	Reversals	Mean Time
1	1937	17	0.93	100.00%	2	1	5.15
2	1131	35.9	0.8	85.70%	0	1	6.08
4	•	•	•	•	•	•	•
5	1737	27.8	1	100.00%	0	0	4.85
6	1788	24.8	0.94	100.00%	1	2	2.56
7	546	50.5	0.91	55.50%	0	7	11.28
8	1175	37.2	1.29	66.67%	4	2	4.78
9	1413	33.2	1.08	88.88%	2	0	6.79
11	1217	34.3	1.06	71.80%	0	2	5.46
12	542	47.9	0.74	51.30%	0	6	4.63
13	270	49.8	0.71	70.60%	4	8	4.39
14	1187	35.4	1.19	66.60%	0	4	6.73
15	1092	41.1	0.86	95.20%	1	2	7.27
means	1169.58	36.24	0.96	79.35%	1.17	2.92	5.83

Note: Asterisks (*) indicate missing data due to computer malfunction

Variable Descriptions

Score : Score calculated from the results of the other variables

Total Time : Time in seconds needed to complete the puzzle

Min/Act Move : Minimum number of moves necessary to complete the puzzle/ Actual nu

% Done : % of the puzzle completed

Errors : Number of incorrect moves

Reversals : Number of moves reversed

Mean Time : Average number of seconds used for each move

Table 4.

CCAB Route Planning

Condition 1

Subject #	Score	Total Time	Minimum/ Valid moves	Number Errors	Number Reversals	Mean Time
1	1407	12.8	1.00	1	0	3.21
2	1329	20.6	1.00	1	0	5.02
4	1216	30.7	0.92	1	2	7.02
5	1147	27.0	0.88	6	2	5.48
6	1076	26.8	0.81	2	2	4.69
7	*	*	*	*	*	*
8	706	60.0	0.67	7	4	8.46
9	1164	29.7	1.00	0	0	6.87
11	1419	11.4	1.00	0	0	2.83
12	*	*	*	*	*	*
13	1269	25.2	1.00	0	0	5.94
14	976	43.0	0.94	3	2	6.44
15	1319	21.7	1.00	0	0	5.19
Means	**1184.36**	**28.1**	**0.93**	**1.91**	**1.09**	**5.56**

Condition 2

Subject #	Score	Total Time	Minimum/ Valid moves	Number Errors	Number Reversals	Mean Time
1	1255	22.3	0.87	1	0	4.66
2	1351	20.1	1.00	0	0	5.32
4	1305	14.0	0.92	1	1	3.16
5	1407	12.0	1.00	0	0	2.82
6	1398	13.1	1.00	1	0	3.07
7	1253	26.6	1.00	0	0	6.36
8	*	*	*	*	*	*
9	1418	12.0	1.00	0	0	3.04
11	1409	12.8	1.00	0	0	3.20
12	*	*	*	*	*	*
13	1258	17.8	0.93	2	1	4.00
14	993	43.2	0.87	5	4	7.78
15	*	*	*	*	*	*
Means	**1304.70**	**19.4**	**0.96**	**1.00**	**0.60**	**4.34**

Note: Asterisks (*) indicate missing data due to computer malfunction

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Table 4. (cont.)

CCAB Route Planning

Condition 3

Subject #	Score	Total Time	Minimum/ Valid moves	Number Errors	Number Reversals	Mean Time
1	1154	24.1	0.72	0	1	4.37
2	876	51.6	1.10	1	4	10.99
4	1150	35.7	0.69	3	3	5.19
5	1419	10.7	1.00	0	0	2.50
6	*	*	*	*	*	*
7	1293	22.3	1.00	0	0	3.75
8	884	44.2	1.56	2	0	13.84
9	1112	32.3	1.22	0	0	9.97
11	1328	15.9	0.92	0	1	3.63
12	1333	12.0	0.94	3	1	2.65
13	1380	15.5	1.00	0	0	3.76
14	909	44.7	1.14	1	5	9.18
15	1063	36.1	0.90	1	2	7.55
Means	1158.42	28.8	1.02	0.92	1.42	6.45

Condition 4

Subject #	Score	Total Time	Minimum/ Valid moves	Number Errors	Number Reversals	Mean Time
1	1436	9.2	1.00	0	0	2.23
2	1373	17.8	1.00	0	0	4.76
4	1280	25.3	0.92	0	1	5.98
5	1167	24.7	0.81	0	1	4.69
6	*	*	*	*	*	*
7	1251	29.9	1.00	0	0	7.64
8	872	44.4	2.67	0	1	25.82
9	1162	29.2	1.00	1	0	5.97
11	1410	13.1	1.00	1	0	3.37
12	1036	28.2	0.74	2	2	4.39
13	1395	14.4	1.00	0	0	3.62
14	982	43.6	1.09	2	4	11.28
15	1145	31.7	0.86	1	2	5.75
Means	1209.08	26.0	1.09	0.58	0.92	7.13

Note: Asterisks (*) indicate missing data due to computer malfunction

Table 4. (cont.)

CCAB Route Planning

Condition 5

Subject #	Score	Total Time	Minimum/ Valid moves	Number Errors	Number Reversals	Mean Time
1	1433	9.8	1.00	0	0	2.45
2	1414	11.9	1.00	0	0	2.92
4	*	*	*	*	*	*
5	1214	12.3	0.81	0	2	2.18
6	1383	15.1	1.00	0	0	3.64
7	1050	33.9	1.22	2	1	6.83
8	766	60.0	2.22	8	0	17.36
9	1229	23.5	0.94	0	1	4.84
11	1424	10.9	1.00	0	0	2.70
12	1313	14.9	0.94	1	1	3.33
13	1177	38.1	1.00	2	0	10.08
14	1122	39.5	1.00	2	0	7.71
15	1063	36.5	0.79	5	2	6.50
Means	**1215.67**	**25.5**	**1.08**	**1.67**	**0.58**	**5.88**

Note: Asterisks (*) indicate missing data due to computer malfunction

Variable Descriptions

Score : Calculation based on results of other variable
Total Time : Total time (seconds) used to complete puzzle
Minimum/Valid moves : Minimum number of moves necessary to complete puzzle/Number of valid moves used.
Number Errors : Number of invalid moves attempted
Number Reversals : Number of moves reversed
Mean Time : Average time (seconds) used for each move

Table 5.

CCAB Number & Words

CONDITION 1 (cold air)

Sub #	Score	% Good Hits	Mean Time	Solved Try 1	Resp Time	Solved Try 2	Resp Time	Total Time	% Solved
1	995	65.51%	0.44	2	33.2	1	1.6	34.8	100.00%
2	898	53.94%	0.55	3	43.1	¥	¥	43.1	100.00%
4	967	48.64%	0.46	2	24.1	0	0.0	44.1	66.67%
5	1336	97.44%	0.29	3	36.1	¥	¥	36.1	100.00%
6	893	83.57%	2.40	1	34.9	2	9.8	44.7	100.00%
7	•	•	•	•	•	•	•	•	•
8	1083	57.22%	0.63	3	26.4	¥	¥	26.4	100.00%
9	1236	71.67%	0.44	3	25.0	¥	¥	25.0	100.00%
11	1218	94.87%	0.46	3	41.7	¥	¥	41.7	100.00%
12	•	•	•	•	•	•	•	•	•
13	1317	97.22%	0.56	3	37.2	¥	¥	37.2	100.00%
14	1247	78.94%	0.52	3	30.8	¥	¥	30.8	100.00%
15	1309	77.13%	0.31	3	24.5	¥	¥	24.5	100.00%
Means	**1136.27**	**75.10%**	**0.64**	**2.64**	**32.5**	**1.00**	**3.8**	**35.3**	**96.97%**

CONDITION 2 (cold water)

Sub #	Score	% Good Hits	Mean Time	Solved Try 1	Resp Time	Solved Try 2	Resp Time	Total Time	% Solved
1	934	80.65%	0.37	1	37.2	2	5.8	43.0	100.00%
2	1023	52.38%	0.63	3	29.6	¥	¥	29.6	100.00%
4	901	49.83%	0.35	3	40.3	¥	¥	40.4	100.00%
5	1627	100.00%	0.32	3	17.9	¥	¥	17.9	100.00%
6	1289	86.00%	0.49	3	31.7	¥	¥	31.7	100.00%
7	1152	77.77%	0.38	3	37.8	¥	¥	37.8	100.00%
8	1022	79.00%	0.67	2	32.0	1	3.4	35.4	100.00%
9	1210	83.33%	0.57	3	36.9	¥	¥	36.9	100.00%
11	1175	95.56%	0.42	3	44.2	¥	¥	44.2	100.00%
12	•	•	•	•	•	•	•	•	•
13	1572	94.44%	0.65	3	17.4			17.4	100.00%
14	•	•	•	•	•	•	•	•	•
15	•	•	•	•	•	•	•	•	•
Means	**1190.50**	**79.90%**	**0.49**	**2.70**	**32.5**	**1.50**	**4.6**	**33.4**	**100.00%**

Note: Asterisks (*) indicate missing data due to computer malfunction.
¥ indicate no data because problem was solved on the first try.

Table 5. (cont.)

CCAB Number & Words

CONDITION 3 (cold water fatigued)

Sub #	Score	% Good Hits	Mean Time	Solved Try 1	Resp Time	Solved Try 2	Resp Time	Total Time	% Solved
1	1248	75.56%	0.38	2	16.4	1	14.8	31.2	100.00%
2	871	53.53%	0.67	2	30.6	1	9.4	40.0	100.00%
4	970	57.41%	0.54	3	38.7	✗	✗	38.7	100.00%
5	1438	94.87%	0.31	3	28.1	✗	✗	28.1	100.00%
6	•	•	•	•	•	•	•	•	•
7	1509	94.44%	0.44	3	22.4	✗	✗	22.4	100.00%
8	1085	76.18%	0.57	3	42.0	✗	✗	42.0	100.00%
9	950	83.71%	0.58	1	21.4	1	4.2	45.6	66.67%
11	1282	97.62%	0.45	3	39.1	✗	✗	39.1	100.00%
12	1396	97.22%	0.57	3	32.4	✗	✗	32.4	100.00%
13	1345	88.89%	0.72	3	29.1	✗	✗	29.1	100.00%
14	965	85.58%	0.45	2	43.4	1	1.3	44.7	100.00%
15	1224	80.48%	0.36	3	33.5	✗	✗	33.5	100.00%
Means	**1190.25**	**82.12%**	**0.50**	**2.58**	**31.4**	**1.00**	**7.4**	**35.6**	**97.22%**

CONDITION 4 (cold water exercise)

Sub #	Score	% Good Hits	Mean Time	Solved Try 1	Resp Time	Solved Try 2	Resp Time	Total Time	% Solved
1	800	54.38%	0.35	1	15.1	1	5.9	21.0	66.67%
2	1003	59.44%	0.87	2	30.6	1	1.1	31.7	100.00%
4	812	51.21%	0.36	2	30.1	1	13.9	44.0	100.00%
5	1032	87.45%	0.39	3	48.6	✗	✗	48.6	100.00%
6	•	•	•	•	•	•	•	•	•
7	1035	97.50%	0.56	3	47.7	✗	✗	47.7	100.00%
8	1480	81.48%	0.50	3	15.2	✗	✗	15.2	100.00%
9	1145	78.79%	0.48	2	31.9	1	2.8	34.7	100.00%
11	1228	95.63%	0.53	3	41.7	✗	✗	41.7	100.00%
12	852	96.16%	0.52	1	28.1	0	3.5	51.6	33.33%
13	1455	100.00%	0.49	3	29.9	0		30.0	100.00%
14	978	68.18%	0.54	2	27.8	0	7.0	34.8	66.67%
15	1510	97.22%	0.33	3	24.2	✗	✗	24.2	100.00%
Means	**1110.83**	**79.79%**	**0.49**	**2.33**	**30.9**	**0.57**	**5.7**	**35.4**	**88.89%**

Note: Asterisks (•) indicate missing data due to computer malfunction.
✗ indicate no data because problem was solved on the first try.

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Table 5. (cont.)

CCAB Number & Words

CONDITION 5 (cold water exercise fatigued)

Sub #	Score	% Good Hits	Mean Time	Solved Try 1	Resp Time	Solved Try 2	Resp Time	Total Time	% Solved
1	1294	78.77%	0.11	3	26.0	¥	¥	26.0	100.00%
2	995	52.15%	0.61	3	32.5	¥	¥	32.5	100.00%
4	•	•	•	•	•	•	•	•	•
5	1479	100.00%	0.34	3	28.5	¥	¥	28.5	100.00%
6	1214	93.33%	0.45	2	31.4	1	1.5	32.9	100.00%
7	885	86.12%	0.63	3	53.8	¥	¥	53.8	100.00%
8	1006	71.21%	0.66	2	40.7	0	3.3	44.0	66.67%
9	1517	100.00%	0.42	3	25.4	¥	¥	25.4	100.00%
11	1152	94.12%	0.45	3	44.8	¥	¥	44.8	100.00%
12	1284	93.87%	0.86	3	35.4	¥	¥	35.4	100.00%
13	1197	92.31%	0.61	3	41.8	¥	¥	41.8	100.00%
14	1190	87.22%	0.36	2	29.0	1	4.1	33.1	100.00%
15	1295	82.28%	0.40	3	29.7	¥	¥	29.7	100.00%
Means	**1209.00**	**85.78%**	**0.49**	**2.75**	**34.9**	**0.67**	**3.0**	**35.7**	**97.22%**

Note: Asterisks (*) indicate missing data due to computer malfunction.

¥ indicate no data because problem was solved on the first try.

Variable Descriptions:

Score : Score based on results of the other variables

% Good Hits : % of responses that were correct

Mean Time : Average time (seconds) per response

Solved Try 1 : Number of problems solved on the first attempt

Resp Time : Seconds for first attempt at solving word puzzle

Solved Try 2 : Number of problems solved on the second attempt (if a second try was need

Resp Time : Seconds for second attempt at solving word puzzle

Total Time : Total time (seconds) used to solve puzzle

% Solved : % of problems solved correctly

Table 6.
CCAB Marking Numbers

CONDITION 1 (cold air)

Subject #	Score	Total Time	Mean Time	Interruption % Hits	Task Mean Time
1	1157	60.0	4.43	100	3.53
2	1198	30.0	3.91	100	4.00
4	1415	57.7	4.43	100	3.19
5	1500	43.2	3.01	100	3.88
6	1258	60.0	2.92	100	3.72
7	*	*	*	*	*
8	1169	60.0	3.44	100	4.85
9	1081	60.0	4.51	100	6.03
11	1375	58.0	3.37	100	4.45
12	*	*	*	*	*
13	959	60.0	6.17	100	5.26
14	1112	60.0	4.41	100	4.70
15	788	60.0	2.38	38	5.82
Means	1182.91	55.4	3.91	94.36	4.49

CONDITION 2 (cold water)

Subject #	Score	Total Time	Mean Time	Interruption % Hits	Task Mean Time
1	1304	57.9	2.89	100	4.16
2	1287	58.6	3.19	100	4.20
4	1763	48.1	2.87	86	2.83
5	1695	43.4	2.77	100	4.16
6	1476	57.0	2.66	100	3.08
7	1116	60.0	3.99	100	4.18
8	*	*	*	*	*
9	759	60.0	8.21	*	*
11	1111	60.0	4.10	100	4.32
12	*	*	*	*	*
13	1369	56.9	4.05	100	3.90
14	1073	50.0	3.77	100	4.97
15	*	*	*	*	*
Means	1295.30	55.2	3.85	98.44	3.98

Note: Asterisks(*) indicate missing data due to computer malfunction.

Table 6. (cont.)
CCAB Marking Numbers

CONDITION 3 (cold water fatigued)

Subject #	Score	Total Time	Mean Time	Interruption % Hits	Task Mean Time
1	1271	54.9	3.82	100	3.31
2	1020	30.0	4.07	100	5.59
4	1341	54.4	4.28	100	3.26
5	1781	34.0	2.56	100	2.76
6	•	•	•	•	•
7	1265	58.3	3.40	100	4.82
8	968	60.0	4.24	100	5.92
9	1035	60.0	4.33	100	5.33
11	1162	60.0	3.53	100	3.96
12	1492	57.3	2.96	100	3.33
13	980	60.0	5.17	100	4.19
14	1014	60.0	2.98	88	4.20
15	816	60.0	2.73	38	6.91
Means	1178.75	54.1	3.67	93.83	4.47

CONDITION 4 (cold water exercise)

Subject #	Score	Total Time	Mean Time	Interruption % Hits	Task Mean Time
1	1159	55.7	4.32	100	3.29
2	1328	54.7	3.18	•	•
4	1643	55.4	3.81	100	2.94
5	1674	49.9	2.88	100	4.14
6	•	•	•	•	•
7	1151	60.0	4.16	100	4.98
8	1128	60.0	4.21	100	4.69
9	898	60.0	5.30	88	5.89
11	1153	60.0	3.54	100	4.78
12	1063	60.0	4.17	88	4.62
13	1514	56.3	3.53	100	3.09
14	1129	60.0	3.76	•	•
15	837	60.0	2.89	25	5.79
Means	1223.08	57.7	3.81	90.10	4.42

Note: Asterisks(•) indicate missing data due to computer malfunction.

Table 6. (cont.)
CCAB Marking Numbers

CONDITION 5 (cold water exercise fatigued)

Subject #	Score	Total Time	Mean Time	Interruption Task % Hits	Mean Time
1	1392	54.2	3.64	100	3.22
2	1253	55.0	3.35	100	3.98
4	•	•	•	•	•
5	1725	40.6	3.11	83	3.38
6	1821	52.3	2.41	100	3.03
7	932	60.0	4.64	88	5.87
8	907	60.0	4.43	88	5.08
9	1092	60.0	4.39	100	5.37
11	1453	51.7	3.09	100	4.84
12	1244	60.0	3.32	100	3.89
13	895	60.0	4.06	100	5.81
14	909	60.0	4.38	88	6.09
15	809	60.0	2.67	25	7.14
Means	**1202.67**	**56.2**	**3.62**	**89.33**	**4.81**

Note: Asterisks(*) indicate missing data due to computer malfunction.

Variable Descriptions:

Score : Calculation based on results of the other variables
Total Time : Total time (seconds) used for the exercise
Mean Time : Average time (seconds) used for each move.

Interruption Task
% Hits : % of correct answers to the Interruption Task
Mean Time : Average time (seconds) used for the Interruption Task

Table 7.
CCAB Missing Items

CONDITION 1 (cold air)

Subj #	Score	Time	Accuracy	Letters Score	Letters Time	Letters Accuracy	Numbers Score	Numbers Time	Numbers Accuracy
1	931	6.9	0.531	1028	6.8	0.625	834	6.9	0.438
2	1074	18.2	0.906	1016	19.1	1.000	1132	17.3	0.813
4	1081	12.8	0.688	1239	8.3	0.813	923	17.3	0.563
5	1010	9.9	0.625	1243	7.4	0.813	777	12.3	0.438
6	1278	10.9	0.347	1488	8.4	1.000	1070	13.5	0.625
7	•	•	•	•	•	•	•	•	•
8	1072	9.0	0.625	1489	8.6	1.000	854	9.5	0.250
9	1439	10.6	1.000	1419	10.7	1.000	1459	10.4	1.000
11	1373	8.8	0.906	1547	5.7	1.000	1198	11.9	0.813
12	•	•	•	•	•	•	•	•	•
13	942	19.7	0.656	1003	18.5	0.750	881	20.9	0.563
14	1452	10.5	1.000	1487	8.8	1.000	1417	12.3	1.000
15	1255	10.9	0.813	1298	6.6	0.813	1214	15.2	0.813
Means	1173.36	11.7	0.736	1295.73	9.9	0.892	1050.82	13.4	0.665

CONDITION 2 (cold water)

Subj #	Score	Time	Accuracy	Letters Score	Letters Time	Letters Accuracy	Numbers Score	Numbers Time	Numbers Accuracy
1	1215	8.5	0.719	1525	6.5	1.000	9.5	10.4	0.438
2	1333	10.2	0.906	1273	8.1	0.813	1393	12.4	1.000
4	1439	7.3	0.906	1557	5.4	1.000	1320	9.1	0.813
5	1522	6.6	1.000	1585	4.6	1.000	1459	8.6	1.000
6	1339	7.8	0.813	1575	5.1	1.000	1103	10.4	0.625
7	1369	9.3	0.906	1487	3.7	1.000	1251	9.8	0.813
8	•	•	•	•	•	•	•	•	•
9	1304	12.1	0.906	1189	12.7	0.813	1420	11.5	1.000
11	1225	12.4	0.906	1502	7.6	1.000	948	17.2	0.813
12	•	•	•	•	•	•	•	•	•
13	1332	9.1	0.906	1124	10.3	0.813	1540	7.9	1.000
14	1176	14.4	0.906	981	14.9	0.813	1372	14.0	1.000
15	•	•	•	•	•	•	•	•	•
Means	1325.40	9.8	0.887	1379.80	8.4	0.925	1181.55	11.1	0.850

Note: Asterisks (*) indicate missing data due to computer malfunction.

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Table 7. (cont.)
CCAB Missing Items

CONDITION 3 (cold water fatigued)

Subj #	Score	Time	Accuracy	Letters Score	Letters Time	Letters Accuracy	Numbers Score	Numbers Time	Numbers Accuracy
1	1190	6.6	0.719	1286	6.0	0.813	1093	7.1	0.625
2	1110	16.6	0.781	1106	16.3	0.750	1113	17.0	0.813
4	1176	13.5	0.656	1561	6.0	1.000	791	20.9	0.313
5	1508	6.9	1.000	1579	4.9	1.000	1438	9.0	1.000
6	•	•	•	•	•	•	•	•	•
7	1266	13.4	0.906	1430	10.6	1.000	1102	16.2	0.813
8	1056	7.2	0.625	1247	9.6	0.813	865	4.8	0.438
9	1404	11.6	1.000	1416	10.2	1.000	1392	13.0	1.000
11	1213	11.0	0.781	1487	7.7	1.000	939	14.3	0.563
12	1327	7.0	0.813	1499	7.3	1.000	1156	6.7	0.625
13	1261	10.1	0.813	1233	10.3	0.813	1289	9.8	0.813
14	1207	12.4	0.813	1193	11.5	0.813	1220	13.4	0.813
15	1191	12.3	0.813	1229	10.5	0.813	1153	14.0	0.813
Means	1242.42	10.7	0.810	1355.50	9.2	0.901	1129.25	12.2	0.719

CONDITION 4 (cold water exercise)

Subj #	Score	Time	Accuracy	Letters Score	Letters Time	Letters Accuracy	Numbers Score	Numbers Time	Numbers Accuracy
1	1180	7.1	0.719	1298	5.1	0.813	1062	9.1	0.625
2	1223	13.5	0.906	1253	8.7	0.813	1193	18.3	1.000
4	1159	11.5	0.813	1316	3.8	0.813	1003	19.3	0.813
5	1192	7.7	0.719	1515	7.3	1.000	868	8.2	0.438
6	•	•	•	•	•	•	•	•	•
7	1312	11.7	0.906	1442	9.9	1.000	1183	13.6	0.813
8	1206	13.0	0.813	1487	8.5	1.000	925	17.5	0.625
9	1480	9.1	1.000	1499	7.9	1.000	1461	10.2	1.000
11	1198	12.6	0.813	1521	6.7	1.000	875	18.4	0.625
12	965	7.7	0.531	860	5.8	0.438	1070	9.6	0.625
13	1232	11.8	0.781	1277	8.4	0.813	1187	15.2	0.750
14	1213	10.8	0.813	1257	7.8	0.813	1178	13.8	0.813
15	1347	9.6	0.906	1205	10.3	0.813	1483	8.9	1.000
Means	1225.75	10.5	0.810	1327.90	7.5	0.860	1124.00	13.5	0.761

Note: Asterisks (*) indicate missing data due to computer malfunction.

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Table 7. (cont.)
CCAB Missing Items

CONDITION 5 (cold water exercise fatigued)

Subj #	Score	Time	Accuracy	Letters Score	Letters Time	Letters Accuracy	Numbers Score	Numbers Time	Numbers Accuracy
1	1073	6.4	0.625	1050	5.6	0.625	1095	7.3	0.625
2	1470	10.2	1.000	1466	9.0	1.000	1474	11.3	1.000
4	•	•	•	•	•	•	•	•	•
5	1233	8.5	0.813	1245	7.3	0.813	1231	9.7	0.813
6	1439	8.4	0.906	1502	7.7	1.000	1376	9.1	0.813
7	1171	16.6	0.906	1266	15.9	1.000	1075	17.4	0.813
8	904	11.6	0.531	1167	11.4	0.813	641	11.7	0.250
9	1451	10.1	1.000	1464	9.1	1.000	1442	11.0	1.000
11	1180	14.6	0.875	1428	9.9	1.000	933	19.4	0.750
12	1062	8.4	0.625	1277	7.1	0.813	847	9.7	0.438
13	710	21.1	0.406	874	18.1	0.563	545	24.1	0.250
14	1177	11.3	0.719	1220	9.3	0.813	1135	13.3	0.625
15	1322	11.2	0.906	1273	9.4	0.813	1372	13.0	1.000
Means	**1183.08**	**11.5**	**0.776**	**1269.33**	**10.0**	**0.854**	**1097.17**	**13.1**	**0.698**

Note: Asteriske (*) indicate missing data due to computer malfunction.

Variable Descriptions:

Score : Calculation based on speed and accuracy of responses (both letters & numbers)
Time : Time needed to solve problems
Accuracy : % of correct answers

Letters : Scores of the problems which used letters
Numbers : Scores of the problems which used numbers

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Table 8.

Rectal Temperatures in °C

Condition 1

time minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	37.4	37.9	38.3	37.1	37.4	38.0	37.7	37.4	37.5	37.6	38.0	37.1	37.7	37.6
5	37.8	37.9	38.3	37.6	37.5	37.9	37.7	37.5	37.6	37.7	38.0	37.2	37.9	37.7
15	37.8	37.9	38.2	37.6	37.6	37.8	37.8	37.5	37.7	37.6	37.9	37.3	37.9	37.8
25	37.8	37.9	38.2	37.6	37.7	37.9	37.8	37.6	37.7	37.6	37.9	37.2	37.9	37.7
35	37.7	37.9	38.1	37.6	37.6	37.9	37.7	37.5	37.6	37.7	37.9	37.2	37.7	37.7
45	37.7	37.7	38.0	37.6	37.6	37.7	37.7	37.5	37.6	37.6	37.8	37.1	37.6	37.6
55	37.6	37.6	38.0	37.6	37.6	37.7	37.6	37.4	37.5	37.6	37.7	37.1	37.5	37.6
65	37.4	37.6	37.7	37.4	37.4	37.6	37.4	37.2	37.2	37.4	37.5	36.9	37.2	37.4
75	37.4	37.4	37.6	37.3	37.3	37.5	37.4	37.1	37.1	37.2	37.5	37.0	37.0	37.3
85	37.4	37.3	37.4	37.1	37.2	37.6	37.3	37.0	37.1	37.2	37.4	36.9	36.9	37.2
95	37.6	37.2	37.2	37.0	37.2	37.6	37.2	37.0	37.2	37.1	37.3	36.7	36.8	37.2
105	37.5	37.2	37.2	37.1	37.3	37.8	37.2	37.0	37.1	37.1	37.3	36.7	36.9	37.2
115	37.5	37.2	37.3	37.1	37.3	37.8	37.2	36.9	37.1	37.1	37.3	36.8	36.9	37.2
125	37.5	37.3	37.4	37.2	37.3	37.9	37.4	36.9	37.2	37.1	37.4	36.8	37.0	37.3
135	37.5	37.4	37.5	37.3	37.2	37.9	37.3	36.9	37.3	37.1	37.4	36.9	37.1	37.3

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

Table 8 (cont.)

Rectal Temperatures in °C

Condition 2

time minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	37.9	38.0	37.9	37.3	37.4	37.9	38.1	37.4	37.3	37.4	38.1	37.0	37.6	37.6
5	38.1	38.0	37.8	37.4	37.6	38.1	38.1	37.5	37.4	37.7	38.2	37.3	37.6	37.8
15	38.2	37.9	37.7	37.5	37.7	38.2	38.1	37.5	37.5	37.7	38.2	37.2	37.5	37.8
25	38.2	37.9	37.6	37.5	37.8	38.2	38.0	37.6	37.6	37.6	38.1	37.2	37.5	37.8
35	38.2	37.9	37.5	37.6	37.8	38.2	38.0	37.5	37.7	37.6	38.1	37.0	37.4	37.7
45	38.2	37.8	37.5	37.6	37.7	38.2	38.0	37.5	37.7	37.6	38.1	37.1	37.3	37.7
55	38.2	37.7	37.5	37.5	37.7	38.2	37.9	37.4	37.7	37.5	38.0	37.0	37.1	37.6
65	38.0	37.6	37.4	37.3	37.5	38.0	37.7	37.2	37.5	37.4	37.9	36.8	36.8	37.5
75	38.1	37.4	37.4	37.2	37.4	38.1	37.6	37.1	37.4	37.3	37.7	36.7	36.8	37.4
85	38.1	37.3	37.4	37.1	37.2	38.1	37.6	37.0	37.3	37.3	37.7	36.5	36.7	37.3
95	38.2	37.4	37.3	37.2	37.2	38.2	37.5	37.0	37.2	37.2	37.6	36.3	36.7	37.3
105	38.4	37.5	37.4	37.2	37.2	38.4	37.5	37.0	37.2	37.4	37.3	36.3	36.6	37.3
115	38.3	37.6	37.3	37.1	37.3	38.3	37.6	36.9	37.1	37.4	37.4	36.3	36.8	37.3
125	38.3	37.5	37.4	37.1	37.2	38.3	37.7	36.9	37.2	37.4	37.3	36.4	36.8	37.4
135	38.3	37.5	37.4	37.2	37.3	38.3	37.7	36.9	37.2	37.5	37.4	36.5	36.8	37.4

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

Table 8. (cont.)

Rectal Temperatures In °C

Condition 3

time minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	37.7	38.0	37.8	37.5	37.8	37.5	37.8	37.3	37.6	37.6	37.7	36.9	37.8	37.6
5	37.9	38.3	38.0	37.5	37.9	37.6	37.9	37.6	37.7	37.6	37.8	37.1	38.0	37.7
15	37.9	38.2	38.0	37.5	38.1	37.6	37.9	37.6	37.8	37.6	37.8	37.1	37.9	37.8
25	38.0	38.2	37.9	37.5	38.0	37.7	37.9	37.6	37.8	37.5	37.8	37.2	37.8	37.8
35	38.0	38.2	37.8	37.5	38.0	37.6	37.9	37.5	37.9	37.5	37.8	37.2	37.7	37.7
45	37.8	38.0	37.7	37.5	37.9	37.7	37.8	37.4	37.8	37.5	37.8	37.1	37.6	37.7
55	37.8	37.9	37.7	37.5	37.8	37.6	37.8	37.3	37.8	37.4	37.7	37.1	37.5	37.6
65	37.8	37.7	37.5	37.4	37.6	37.5	37.5	37.2	37.7	37.3	37.5	37.0	37.1	37.4
75	37.7	37.5	37.3	37.3	37.5	37.5	37.5	37.1	37.7	37.3	37.3	37.0	37.2	37.4
85	37.7	37.4	37.2	37.1	37.4	37.5	37.4	37.0	37.6	37.3	37.1	37.0	37.2	37.3
95	37.8	37.3	37.1	37.2	37.5	37.5	37.4	36.8	37.5	37.4	37.2	36.9	37.3	37.3
105	37.7	37.3	37.1	36.9	37.6	37.5	37.5	36.8	37.5	37.5	37.3	36.9	37.3	37.3
115	37.7	37.2	37.1	37.1	37.6	37.6	37.5	36.7	37.4	37.5	37.2	36.8	37.5	37.3
125	37.8	37.3	37.3	37.2	37.7	37.6	37.6	36.7	37.4	37.5	37.5	36.7	37.6	37.4
135	37.8	37.3	37.3	37.2	37.7	37.6	37.6	36.8	37.5	37.4	37.5	36.8	37.5	37.4

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

Table 8. (cont.)

Rectal Temperatures In °C

Conditon 4

time minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	38.0	37.9	38.0	37.9	37.9	37.9	37.5	37.1	37.2	37.8	37.9	37.3	37.8	37.7
5	38.1	37.9	38.0	38.0	38.1	37.9	37.7	37.2	37.6	38.0	38.0	37.3	37.9	37.8
15	38.1	38.0	37.9	37.8	38.1	37.9	37.7	37.1	37.7	38.0	38.0	37.3	37.8	37.8
25	38.5	38.2	38.2	38.2	38.3	38.2	38.3	37.5	37.9	38.2	38.4	37.5	38.3	38.1
35	36.6	38.3	38.2	38.1	38.3	38.2	38.4	37.6	38.1	38.3	38.2	37.8	38.3	38.2
45	38.8	38.4	38.2	38.2	38.3	38.4	38.5	37.6	38.1	38.4	38.2	37.9	38.3	38.3
55	38.8	38.7	38.3	38.3	38.4	38.4	38.5	37.8	38.3	38.5	38.5	38.2	38.6	38.4
65	38.6	38.5	38.0	38.0	38.2	38.2	38.3	37.4	38.1	38.4	38.0	38.0	38.2	38.1
75	38.5	38.5	37.8	37.9	38.1	38.2	38.1	37.2	38.3	38.2	37.9	37.9	38.0	38.0
85	38.3	38.3	37.6	37.6	37.7	38.0	37.9	36.8	37.7	38.1	37.6	37.6	37.7	37.8
95	37.9	37.9	37.4	37.5	37.6	37.8	37.8	36.7	37.7	37.9	37.5	37.3	37.4	37.6
105	37.8	37.7	37.3	37.4	37.5	37.7	37.6	36.6	37.5	37.8	37.5	37.1	37.2	37.4
115	37.7	37.6	37.3	37.4	37.6	37.6	37.5	36.6	37.3	37.7	37.4	37.1	37.1	37.4
125	37.7	37.6	37.3	37.4	37.5	37.7	37.6	36.8	37.4	37.5	37.4	37.1	37.0	37.4
135	37.8	37.6	37.4	37.4	37.6	37.6	37.6	36.8	37.4	37.6	37.3	37.1	37.0	37.4

Notes: Column numbers are the subject Identifiers

Temperatures are 10 minute averages

Table 8. (cont.)

Rectal Temperatures in °C

Condition 5

time minutes	1	2	4	5	6	7	8	r	11	12	13	14	15	1-15
0	38.0	37.1	37.8	37.1	37.7	37.7	37.3	37.3	37.9	37.9	37.5	•	38.0	37.6
5	38.0	37.6	38.0	37.1	37.7	37.7	37.5	37.4	38.0	38.0	37.9	•	37.9	37.7
15	37.9	37.6	37.8	37.2	37.6	37.8	37.5	37.3	38.0	38.0	37.8	•	37.7	37.7
25	38.3	37.9	38.1	37.4	37.9	38.0	37.9	37.6	38.2	38.1	38.2	•	37.9	37.9
35	38.3	38.0	38.1	37.5	38.0	38.1	37.9	37.8	38.2	38.3	38.2	•	38.0	38.0
45	38.6	38.2	38.3	37.6	38.0	38.1	38.2	37.8	38.1	38.3	38.4	•	38.2	38.2
55	38.6	38.3	38.4	37.8	38.1	38.2	38.3	37.9	38.3	38.5	38.5	•	38.3	38.3
65	38.5	38.2	38.1	37.7	37.9	38.1	38.2	37.8	38.1	38.3	38.1	•	38.2	38.1
75	38.4	38.1	37.9	37.7	37.7	38.0	38.1	37.8	37.9	38.2	37.9	•	38.0	38.0
85	38.2	37.8	37.6	37.5	37.5	37.8	37.9	37.7	37.7	38.0	37.6	•	37.6	37.7
95	38.0	37.6	37.4	37.5	37.4	37.6	37.7	37.4	37.6	37.8	37.4	•	37.5	37.6
105	37.9	37.5	37.3	37.4	37.3	37.4	37.6	37.1	37.6	37.8	37.4	•	37.3	37.5
115	37.8	37.5	37.3	37.4	37.1	37.4	37.5	37.0	37.4	37.7	37.2	•	37.1	37.4
125	37.7	37.6	37.3	37.4	37.1	37.4	37.5	37.1	37.5	37.6	37.2	•	37.2	37.4
135	37.7	37.6	37.3	37.5	37.0	37.4	37.5	37.1	37.6	37.6	37.1	•	37.2	37.4

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

• Data lost due to technical problems

Table 9.

Mean Skin Temps in °C

Condition 1

time minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	34.0	33.1	30.1	32.7	33.1	33.0	32.0	32.2	32.7	30.1	33.2	32.8	32.9	32.5
5	31.9	31.4	27.8	30.7	32.2	31.0	30.4	30.5	30.6	28.3	31.6	29.4	31.1	30.5
15	29.9	29.9	28.4	29.0	30.5	29.2	28.7	28.7	28.6	26.0	30.1	27.7	29.5	28.9
25	28.7	29.0	27.3	28.1	29.9	28.6	28.0	27.7	27.6	24.7	29.4	26.8	28.7	28.0
35	27.6	28.4	26.8	27.5	29.1	28.4	27.4	27.0	26.8	23.6	29.1	25.7	28.3	27.4
45	26.9	28.0	26.2	27.1	28.7	28.2	26.9	26.7	26.4	22.9	28.8	24.8	27.9	26.9
55	26.4	27.4	26.6	26.6	28.6	27.9	26.4	26.4	26.1	22.5	28.4	22.8	27.3	26.4
65	26.1	27.4	21.3	26.3	28.1	28.0	26.5	25.4	26.2	22.6	28.0	25.3	26.6	26.0
75	26.2	27.2	21.2	25.9	28.5	27.8	25.8	25.1	25.9	22.1	27.9	24.5	26.6	25.7
85	26.5	27.6	22.9	26.2	28.8	28.0	25.7	25.0	25.7	20.4	28.0	24.7	27.2	25.9
95	26.7	27.8	21.7	26.8	29.3	28.6	25.7	24.7	25.9	20.2	28.3	25.2	27.2	26.0
105	26.7	28.2	23.1	26.6	29.0	28.6	25.6	24.6	25.6	25.1	28.5	25.2	27.2	26.4
115	26.8	28.3	21.0	26.7	29.0	28.8	25.6	24.1	25.8	25.0	28.5	25.0	26.8	26.3
125	26.6	28.1	23.3	26.9	28.9	29.1	25.5	24.3	25.7	24.1	28.5	25.1	26.5	26.4
135	26.9	27.7	22.7	26.6	28.6	28.9	26.0	23.7	25.8	22.8	28.5	24.3	26.5	26.1

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

Table 9. (cont)

Mean Skin Temps in °C

Condition 2

minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	33.8	31.4	33.5	34.4	33.6	34.1	32.0	32.5	33.3	33.3	35.5	33.2	31.5	33.2
5	32.4	30.8	32.1	31.6	32.0	32.8	28.4	30.7	31.3	30.1	32.7	31.9	29.6	31.2
15	30.8	29.9	30.7	29.8	30.8	31.3	27.2	29.0	29.0	27.8	34.0	30.3	28.3	29.9
25	29.1	29.1	29.8	28.9	30.2	29.8	25.7	28.0	28.0	26.8	30.9	29.4	27.4	28.7
35	28.0	28.5	29.2	28.3	29.4	28.9	24.6	27.6	27.1	25.5	30.2	28.8	26.7	27.9
45	27.1	27.9	28.7	27.6	28.9	28.0	23.9	27.2	26.4	24.7	30.0	28.2	26.5	27.3
55	26.7	27.2	28.4	27.1	28.7	27.6	24.2	26.7	25.5	24.3	29.4	27.8	26.2	26.9
65	26.5	27.1	26.0	25.8	28.5	27.4	25.1	26.7	25.5	23.7	29.2	27.8	25.7	26.7
75	26.5	27.0	28.2	25.6	28.8	27.3	25.1	26.5	25.3	24.2	29.4	28.1	26.2	26.8
85	26.4	27.5	29.1	25.3	29.3	27.2	25.1	26.4	25.3	24.4	29.2	28.6	26.7	27.0
95	26.7	27.4	28.2	26.3	29.4	27.3	25.2	26.7	25.2	24.1	28.8	28.8	26.7	27.0
105	26.9	27.9	28.6	26.5	29.1	27.6	25.0	26.5	25.2	24.8	29.7	28.7	26.7	27.2
115	27.2	26.6	29.2	25.6	29.0	27.9	25.2	26.8	25.3	24.6	29.5	28.7	26.2	27.0
125	27.1	26.8	28.2	25.8	28.6	27.9	25.2	26.7	25.2	25.2	29.6	28.5	26.4	27.0
135	27.1	27.7	27.5	25.1	28.4	27.7	24.9	26.7	25.3	24.9	29.9	28.6	26.4	26.9

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

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Table 9 (cont)

Mean Skin Temps in °C

Condition 3

minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	32.9	34.8	34.1	32.8	33.7	32.8	33.8	34.7	33.4	33.4	34.2	33.2	34.2	33.7
5	31.2	33.1	31.3	31.3	33.1	32.9	29.4	31.8	32.2	31.1	32.6	31.5	31.3	31.7
15	29.2	31.8	30.0	30.1	31.6	30.0	27.0	29.9	30.5	29.2	30.9	30.0	29.4	30.0
25	28.6	30.6	29.2	29.1	30.6	28.6	26.4	29.1	29.5	28.1	30.0	29.2	28.4	29.0
35	27.7	29.8	28.2	28.5	30.3	28.2	26.5	28.1	28.9	27.4	29.5	28.4	27.7	28.4
45	27.0	29.3	27.5	28.1	29.7	28.0	26.3	27.9	28.6	26.7	29.4	28.2	27.2	28.0
55	26.5	28.8	27.2	27.6	29.1	27.8	25.1	27.5	28.3	26.0	29.4	27.7	27.2	27.6
65	26.3	28.8	26.6	26.5	29.9	27.4	26.2	27.2	27.7	25.8	29.5	27.9	26.8	27.4
75	26.6	29.0	27.6	26.6	29.2	27.4	25.5	27.0	27.5	25.9	29.6	28.1	26.9	27.5
85	27.1	29.3	28.7	26.9	29.7	27.3	25.7	27.0	27.6	26.0	29.5	28.4	27.5	27.7
95	27.3	29.2	28.3	27.2	30.1	27.2	26.0	27.1	27.6	25.9	29.9	28.8	27.5	27.9
105	27.0	29.1	28.9	27.2	29.8	27.4	25.7	26.9	27.7	26.1	29.8	28.6	27.5	27.8
115	27.0	29.2	28.3	27.4	30.0	27.1	26.3	26.8	27.5	25.8	29.8	28.8	27.3	27.8
125	27.0	29.1	29.0	26.9	30.0	27.1	26.0	26.9	27.4	26.3	29.9	28.9	27.4	27.9
135	26.8	28.7	29.5	26.6	30.4	27.0	26.0	26.7	27.3	25.1	29.7	28.6	27.0	27.6

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

Table 9. (cont.)

Mean Skin Temps in °C

Condition 4

minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	33.2	32.6	34.2	34.4	34.6	32.9	35.0	33.3	32.8	32.4	34.2	34.0	32.2	33.5
5	31.0	32.2	32.7	33.0	32.4	31.4	31.6	31.2	31.2	30.5	32.7	32.8	30.4	31.8
15	28.4	30.8	31.2	30.9	30.7	29.5	28.7	28.8	28.4	27.8	29.9	30.8	27.9	29.5
25	29.5	30.0	31.3	31.3	30.7	29.8	27.6	28.5	27.8	25.1	30.4	31.1	28.4	29.3
35	27.9	29.9	30.9	30.4	30.5	29.5	27.6	28.0	27.4	23.2	30.0	30.7	26.7	28.7
45	28.1	29.1	30.2	30.0	30.5	28.9	27.0	27.4	27.3	23.1	29.4	31.2	26.0	28.3
55	29.0	30.0	30.5	30.4	30.4	28.7	27.6	28.1	26.9	27.1	30.3	31.9	25.3	28.9
65	28.3	29.6	30.3	30.1	29.9	29.3	27.8	28.1	27.3	26.0	30.1	31.7	25.6	28.8
75	28.0	29.2	29.9	29.7	29.7	28.7	27.8	28.0	27.1	24.7	30.4	31.1	26.0	28.5
85	27.6	29.2	30.1	29.4	29.8	28.1	27.7	27.4	26.6	23.0	30.4	30.7	25.4	28.1
95	27.1	28.8	30.1	29.2	29.7	28.1	27.0	27.8	26.7	22.7	30.4	30.4	25.7	28.0
105	26.8	29.1	30.0	29.3	29.3	28.0	27.0	27.3	26.3	22.4	30.2	30.6	25.4	27.8
115	26.3	29.2	30.0	29.4	29.7	28.3	27.1	27.7	26.1	22.6	30.1	30.1	24.6	27.8
125	26.4	28.9	29.9	29.3	29.3	28.1	27.0	27.3	25.9	22.4	30.1	30.2	25.4	27.7
135	26.6	28.6	29.8	28.9	29.9	28.3	27.3	27.3	25.8	22.7	29.4	30.2	25.0	27.6

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

Table 9. (cont.)

Mean Skin Temps in °C

Condition 5

minutes	1	2	4	5	6	7	8	9	11	12	13	14	15	1-15
0	33.1	33.8	34.0	32.2	35.0	34.1	32.0	32.2	33.2	32.0	34.3		33.8	33.3
5	31.2	31.6	32.6	30.8	32.1	32.8	29.1	31.2	30.5	28.5	32.9	•	31.5	31.2
15	28.3	29.5	30.6	28.8	30.0	30.8	26.5	29.0	28.0	25.6	30.7	•	30.1	29.0
25	28.5	28.4	30.3	28.9	30.8	30.9	25.9	28.6	27.4	24.6	30.5	•	30.5	28.8
35	28.0	28.6	30.2	29.1	29.7	30.8	25.5	28.5	27.9	24.7	30.6	•	28.0	28.5
45	25.6	27.1	30.6	28.6	29.8	29.9	25.0	27.6	26.9	23.4	30.3	•	28.5	27.8
55	27.5	28.2	30.5	29.3	30.6	30.6	25.1	28.1	27.1	25.3	29.8	•	28.5	28.4
65	26.0	28.4	30.1	28.7	29.9	30.6	24.5	28.3	27.1	23.1	29.8	•	27.5	27.8
75	26.2	27.7	29.3	28.3	28.8	30.1	24.3	27.7	26.8	22.8	29.6	•	28.3	27.5
85	25.3	27.9	29.7	28.5	29.2	29.5	24.6	27.9	26.7	23.5	30.1	•	28.9	27.6
95	25.3	27.9	29.7	28.5	29.3	29.6	23.8	27.3	26.5	22.6	29.9	•	28.1	27.4
105	25.2	28.5	29.6	28.2	28.5	29.5	23.7	27.3	26.7	22.9	29.6	•	28.8	27.4
115	24.8	28.1	29.3	28.2	28.5	29.5	23.6	27.8	26.1	23.1	29.6	•	28.2	27.2
125	24.8	27.7	29.5	28.1	28.4	29.5	23.4	27.5	26.1	22.3	29.3	•	28.4	27.1
135	24.7	27.1	29.4	27.7	28.0	29.4	23.5	27.3	26.1	23.1	29.4	•	28.1	27.0

• Data lost due to technical problem

Notes: Column numbers are the subject identifiers

Temperatures are 10 minute averages

Table 10

F.A.T.S. Shooting Performance
100 yard Range Targets

Condition 1

Subject #	Score Target 1	Score Target 2	Score Target 3	Score Target 4	total time	total hits	total shots	total score	% score
1	75	77	84	67	102	39	40	303	75.8%
2	76	73	77	71	160	40	40	297	74.3%
4	.	.	.	.	.	.	.	.	.
5	85	87	88	83	219	40	40	343	85.8%
6	76	78	84	79	129	39	40	317	79.3%
7	87	92	85	91	180	40	40	355	88.8%
8	86	92	86	88	174	40	40	352	88.0%
9	68	87	91	78	206	38	40	324	81.0%
11	86	79	86	97	116	40	40	348	87.0%
12	88	87	86	87	115	40	40	348	87.0%
13	84	87	87	93	223	39	39	351	87.8%
14	68	79	56	83	145	36	40	286	71.5%
15	81	91	87	88	140	40	40	347	86.8%
means	80.0	84.1	83.1	83.8	159.1	39.3	39.8	330.9	0.8
s.d.	7.21	6.53	9.14	8.64	41.63	1.22	0.29	24.50	6.13
s.e.m.	2.08	1.88	2.64	2.55	12.02	0.35	0.08	7.07	1.77

Condition 2

* indicate missing data due to equipment malfunction

Subject #	Score Target 1	Score Target 2	Score Target 3	Score Target 4	total time	total hits	total shots	total score	% score
1	70	60	66	74	43	37	40	270	67.50%
2	67	78	81	83	133	40	40	309	77.25%
4	83	84	81	86	.	40	40	334	83.50%
5	81	70	75	92	210	37	38	318	79.50%
6	75	76	81	87	108	38	40	319	79.75%
7	83	83	88	93	168	40	40	345	86.25%
8	79	89	85	87	179	40	40	340	85.00%
9	89	93	91	92	199	40	40	365	91.25%
11	74	78	83	88	184	39	39	323	80.75%
12	72	77	88	93	93	38	40	330	82.50%
13	63	85	89	83	234	37	37	320	80.00%
14	84	87	77	86	151	40	40	334	83.50%
15	88	87	81	82	99	40	40	338	84.50%
means	77.5	80.5	81.8	86.6	150.1	38.9	39.5	326.6	81.6
s.d.	8.11	6.54	4.86	4.61	47.14	1.24	1.08	15.02	3.76
s.e.m.	2.34	1.88	1.39	1.16	14.21	0.36	0.29	4.34	1.08

Table 10 (cont)

F.A.T.S. Shooting Performance
100 yard Range Targets

Condition 3

Subject #	Score Target 1	Score Target 2	Score Target 3	Score Target 4	total time	total hits	total shots	total score	% score
1	79	72	70	74	107	38	40	295	73.75%
2	78	80	85	91	183	39	40	334	83.50%
4	88	74	85	85	142	40	40	330	82.50%
5	68	82	83	87	220	38	38	320	80.00%
6	82	80	83	80	111	40	40	325	81.25%
7	81	79	85	81	209	40	40	326	81.50%
8	85	91	93	90	179	40	40	359	89.75%
9	84	88	94	92	153	40	40	358	89.50%
11	73	86	85	90	144	39	40	334	83.50%
12	79	79	81	77	85	38	40	316	79.00%
13	90	90	88	82	232	40	40	350	87.50%
14	78	79	75	85	134	40	40	317	79.25%
15	66	71	85	86	132	38	40	308	77.00%
means	79.2	80.8	84.0	84.6	156.2	39.2	39.8	328.6	82.2
s.d.	7.21	6.14	5.02	4.78	44.91	0.89	0.58	16.58	4.14
s.e.m.	2.08	1.77	1.45	1.36	12.97	0.26	0.17	4.79	1.20

Condition 4

Subject #	Score Target 1	Score Target 2	Score Target 3	Score Target 4	total time	total hits	total shots	total score	% score
1	80	70	83	79	58	39	40	312	78.00%
2	86	83	88	91	144	40	40	348	87.00%
4	82	85	83	86	106	40	40	336	84.00%
5	63	87	91	68	176	37	40	309	77.25%
6	77	72	85	84	119	40	40	318	79.50%
7	84	82	84	82	154	40	40	332	83.00%
8	83	81	91	93	176	40	40	348	87.00%
9	91	88	96	91	195	40	40	366	91.50%
11	83	90	93	66	113	40	40	352	88.00%
12	63	82	79	87	115	39	40	311	77.75%
13	78	90	93	93	192	40	40	354	88.50%
14	86	82	82	88	123	40	40	338	84.50%
15	92	83	80	87	123	39	40	339	84.75%
means	80.0	82.5	86.0	85.0	138.0	39.5	40.0	338.8	83.9
s.d.	9.35	5.82	5.66	6.72	32.75	0.90	0.06	17.70	4.42
s.e.m.	2.70	1.45	1.64	1.94	9.46	0.26	0.08	5.11	1.28

Table 10 (cont)

F.A.T.S. Shooting Performance
100 yard Range Targets

Condition 5

Subject #	Score Target 1	Score Target 2	Score Target 3	Score Target 4	total time	total hits	total shots	total score	% score
1	83	83	79	84	109	40	40	329	82.25%
2	70	73	79	62	175	39	40	284	71.00%
4	61	80	86	77	89	39	40	304	76.00%
5	82	42	44	39	237	25	25	207	51.75%
6	87	83	89	88	99	40	40	347	86.75%
7	81	82	85	86	149	40	40	334	83.50%
8	86	90	91	92	190	40	40	359	89.75%
9	76	77	93	89	183	40	40	335	83.75%
11	83	89	89	88	167	40	40	349	87.25%
12	80	84	88	86	91	40	40	338	84.50%
13	91	90	88	83	158	40	40	352	88.00%
14	83	76	84	87	125	40	40	330	82.50%
15	85	87	88	87	145	40	40	347	86.75%
means	80.6	79.7	83.3	80.8	147.3	38.7	38.8	324.2	81.1
s.d.	8.14	13.05	12.99	15.21	44.37	4.29	4.33	42.48	10.62
s.e.m.	2.35	3.77	3.75	4.39	12.81	1.24	1.25	12.26	3.06

Table 11.

F.A.T.S. Shooting Performance
Moving Targets

Condition 1

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	2	8	25.0%	25.0%
2	5	8	62.5%	62.5%
4	.	.	.	.
5	3	8	37.5%	37.5%
6	5	8	62.5%	62.5%
7	6	8	75.0%	75.0%
8	4	8	50.0%	50.0%
9	7	8	87.5%	87.5%
11	5	8	62.5%	62.5%
12	7	8	87.5%	87.5%
13	6	8	75.0%	75.0%
14	4	8	50.0%	50.0%
15	5	7	62.5%	71.4%
mean	4.9	7.9	61.5%	62.2%
s.d.	1.5	0.3	18.8	19.0
s.e.m.	0.4	0.1	5.4	5.5

Condition 2

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	2	7	25.0%	28.6%
2	4	8	50.0%	50.0%
4	.	.	.	.
5	5	8	62.5%	62.5%
6	3	8	37.5%	37.5%
7	3	8	37.5%	37.5%
8	5	7	62.5%	71.4%
9	6	8	75.0%	75.0%
11	6	8	75.0%	75.0%
12	6	8	75.0%	75.0%
13	7	8	87.5%	87.5%
14	2	7	25.0%	28.6%
15	7	7	87.5%	100.0%
mean	4.7	7.7	58.3%	60.7%
s.d.	1.8	0.5	22.8	23.8
s.e.m.	0.5	0.1	6.6	6.9

Condition 3

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	4	8	50.0%	50.0%
2	6	8	75.0%	75.0%
4	5	8	62.5%	62.5%
5	5	8	62.5%	62.5%
6	4	8	50.0%	50.0%
7	5	8	62.5%	62.5%
8	5	7	62.5%	71.4%
9	5	8	62.5%	62.5%
11	5	8	62.5%	62.5%
12	8	8	100.0%	100.0%
13	6	8	75.0%	75.0%
14	5	6	62.5%	83.3%
15	8	8	100.0%	100.0%
mean	5.5	7.8	66.3%	70.6%
s.d.	1.3	0.6	15.8	16.1
s.e.m.	0.4	0.2	4.4	4.5

Condition 4

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	4	8	50.0%	50.0%
2	3	7	37.5%	42.9%
4	3	8	37.5%	37.5%
5	4	8	50.0%	50.0%
6	5	8	62.5%	62.5%
7	3	8	37.5%	37.5%
8	4	8	50.0%	50.0%
9	6	8	75.0%	75.0%
11	5	8	62.5%	62.5%
12	3	8	37.5%	37.5%
13	5	8	62.5%	62.5%
14	3	8	37.5%	37.5%
15	8	8	100.0%	100.0%
mean	4.3	7.9	53.8%	54.3%
s.d.	1.5	0.3	16.7	16.3
s.e.m.	0.4	0.1	5.2	5.1

Table 11 (cont.)

F.A.T.S. Shooting Performance
Moving Targets

Condition 5

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	5	7	62.5%	71.4%
2	5	7	62.5%	71.4%
4	3	8	37.5%	37.5%
5	4	8	50.0%	50.0%
6	6	8	75.0%	75.0%
7	4	7	50.0%	57.1%
8	6	7	75.0%	85.7%
9	6	7	75.0%	85.7%
11	6	8	75.0%	75.0%
12	6	8	75.0%	75.0%
13	4	7	50.0%	57.1%
14	7	8	87.5%	87.5%
15	6	8	75.0%	75.0%
mean	5.2	7.5	65.4%	69.5%
s.d.	1.2	0.5	14.6	15.0
s.e.m.	0.3	0.1	4.0	4.2

Variable Descriptions:

Hits: Number of shots that hit a target (8 possible)

Shots: Number of shots fired (8 possible)

% of
Targets hit: Percentage of targets that were hit

% of Shots
that hit: Percentage of shots fired that hit a target

Table 12.

F.A.T.S. Shooting Performance
Quick Kill

Condition 1

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	23	49	42.6%	46.9%
2	28	28	51.9%	100.0%
4	•	•	•	•
5	31	45	57.4%	68.9%
6	29	53	53.7%	54.7%
7	30	45	55.6%	66.7%
8	29	48	53.7%	60.4%
9	23	31	42.6%	74.2%
11	28	30	51.9%	93.3%
12	22	42	40.7%	52.4%
13	35	51	64.8%	68.6%
14	25	39	46.3%	64.1%
15	35	49	64.8%	71.4%
mean	28.2	42.5	52.2%	68.5%
s.d.	4.3	8.6	8.0	15.5
s.e.m.	1.3	2.5	2.3	4.5

Condition 2

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	24	50	44.4%	48.0%
2	21	26	38.9%	80.8%
4	•	•	•	•
5	29	47	53.7%	61.7%
6	29	51	53.7%	56.9%
7	10	54	18.5%	18.5%
8	19	50	35.2%	38.0%
9	23	33	42.6%	69.7%
11	28	29	51.9%	96.6%
12	24	39	44.4%	61.5%
13	35	53	64.8%	66.0%
14	24	42	44.4%	57.1%
15	31	42	57.4%	73.8%
mean	24.8	43.0	45.0%	60.7%
s.d.	6.5	9.5	12.0	20.1
s.e.m.	1.9	2.8	3.5	5.8

Condition 3

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	25	50	46.3%	50.0%
2	26	30	48.1%	86.7%
4	35	45	64.8%	77.8%
5	26	34	48.1%	76.5%
6	30	51	55.6%	58.8%
7	28	48	51.9%	58.3%
8	16	44	29.6%	36.4%
9	19	34	35.2%	55.9%
11	29	30	53.7%	96.7%
12	28	43	51.9%	65.1%
13	34	51	63.0%	66.7%
14	26	35	48.1%	74.3%
15	31	42	57.4%	73.8%
mean	27.2	41.3	50.3%	67.5%
s.d.	5.3	7.6	9.8	16.0
s.e.m.	1.3	2.2	2.7	4.4

Condition 4

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	25	50	46.3%	50.0%
2	27	27	50.0%	100.0%
4	41	51	75.9%	80.4%
5	28	36	51.9%	77.8%
6	31	54	57.4%	57.4%
7	21	50	38.9%	42.0%
8	23	41	42.6%	56.1%
9	21	31	38.9%	67.7%
11	25	29	46.3%	86.2%
12	30	50	55.6%	60.0%
13	35	52	64.8%	67.3%
14	24	42	44.4%	57.1%
15	30	52	55.6%	57.7%
mean	27.8	43.8	51.4%	66.1%
s.d.	5.7	9.8	10.6	16.1
s.e.m.	1.6	2.7	2.9	4.5

Table 12 (cont')

F.A.T.S. Shooting Performance
Quick Kill

Condition S

Subject #	Hits	Shots	% of Targets hit	% of Shots that hit
1	22	48	40.7%	45.9%
2	23	25	42.6%	92.0%
4	43	52	79.6%	82.7%
5	27	53	50.0%	50.9%
6	28	52	51.9%	53.8%
7	26	51	48.1%	51.0%
8	16	44	29.6%	36.4%
9	24	33	44.4%	72.7%
11	26	30	48.1%	86.7%
12	26	52	48.1%	50.0%
13	38	51	70.4%	74.5%
14	27	43	50.0%	62.8%
15	22	47	40.7%	46.8%
mean	26.8	44.7	49.6%	62.0%
s.d.	6.9	9.4	12.8	17.8
s.e.m.	1.9	2.6	3.6	4.9

Variable Descriptions:

Hits: Number of shots that hit a target (8 possible)

Shots: Number of shots fired (8 possible)

% of Targets hit: Percentage of targets that were hit

% of Shots that hit: Percentage of shots fired that hit a target

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Table 13

F.A.T.S. Shooting Performance
Judgemental Courses

Condition 1

Subject #	Judgement %	Hit %	Mean Run
1	100.0%	50.0%	1.267
2	100.0%	60.0%	1.067
4	·	·	·
5	100.0%	66.7%	0.967
6	100.0%	40.0%	0.844
7	100.0%	31.7%	0.967
8	100.0%	57.1%	1.145
9	100.0%	66.7%	0.944
11	100.0%	66.7%	1.078
12	80.0%	50.0%	0.833
13	80.0%	50.0%	0.876
14	100.0%	50.0%	0.922
15	100.0%	66.7%	1.278
means	96.7%	54.6%	1.016
s.d.	7.8%	11.4%	0.152
s.e.	2.2%	3.3%	0.044

Condition 2

Subject #	Judgement %	Hit %	Mean Run
1	80.0%	100.0%	0.889
2	80.0%	100.0%	1.217
4	·	·	·
5	80.0%	100.0%	0.983
6	80.0%	83.3%	0.933
7	80.0%	100.0%	1.050
8	80.0%	75.0%	0.969
9	80.0%	100.0%	0.922
11	80.0%	100.0%	0.978
12	80.0%	80.0%	0.800
13	100.0%	100.0%	0.533
14	100.0%	100.0%	0.978
15	40.0%	100.0%	1.000
means	75.0%	94.9%	0.939
s.d.	17.3%	9.5%	0.162
s.e.	5.0%	2.7%	0.047

Condition 3

Subject #	Judgement %	Hit %	Mean Run
1	80.0%	66.7%	0.322
2	80.0%	33.3%	0.650
4	100.0%	100.0%	0.544
5	100.0%	100.0%	0.355
6	80.0%	100.0%	0.422
7	100.0%	100.0%	0.478
8	100.0%	75.0%	0.455
9	100.0%	83.3%	0.333
11	100.0%	100.0%	0.333
12	100.0%	83.3%	0.422
13	80.0%	100.0%	0.356
14	80.0%	100.0%	0.522
15	100.0%	100.0%	0.533
means	92.3%	89.3%	0.441
s.d.	10.1%	18.0%	0.102
s.e.	2.8%	5.3%	0.028

Condition 4

Subject #	Judgement %	Hit %	Mean Run
1	100.0%	83.3%	0.711
2	100.0%	80.0%	0.867
4	100.0%	85.7%	0.700
5	80.0%	100.0%	0.656
6	80.0%	100.0%	0.578
7	80.0%	100.0%	0.789
8	100.0%	100.0%	0.856
9	100.0%	100.0%	0.767
11	100.0%	100.0%	0.656
12	100.0%	100.0%	0.700
13	100.0%	57.1%	0.589
14	100.0%	86.7%	0.733
15	100.0%	100.0%	0.811
means	93.3%	89.4%	0.717
s.d.	13.0%	16.0%	0.092
s.e.	3.6%	4.3%	0.027

Table 13 (cont)

F.A.T.S. Shooting Performance
Judgmental Courses

Condition 5

Subject #	Judgment %	Hit %	Mean Rxn
1	100.0%	83.3%	0.322
2	100.0%	100.0%	0.883
4	80.0%	100.0%	0.711
5	100.0%	100.0%	0.655
6	100.0%	83.3%	0.600
7	50.0%	100.0%	1.000
8	100.0%	100.0%	0.634
9	100.0%	100.0%	0.622
11	80.0%	100.0%	0.917
12	100.0%	83.3%	0.722
13	60.0%	100.0%	0.517
14	100.0%	100.0%	0.467
15	100.0%	100.0%	0.800
means	90.0%	96.2%	0.666
s.d.	17.3%	7.3%	0.179
s.e.	4.6%	2.0%	0.050

Variable Descriptions:

Judgment %: Percentage of times the "correct"
response was used

Hit %: Percentage of shots fired that hit
the target

Mean rxn: Average reaction time (from start
of threat to time of firing)

Table 14 .

Catecholamines

	mean Norepl	s.e.m. Norepl	mean Epl	s.e.m. Epl	mean Dopamine	s.e.m. Dopamine	mean epl/norepl	s.e.m. epl/norepl
C1 pre	45.56	5.59	12.05	1.85	241.83	55.50	0.27	0.03
C1 post	74.08	8.55	17.55	2.86	204.02	46.96	0.24	0.03
C2 pre	40.94	4.21	9.32	1.48	184.35	21.47	0.22	0.02
C2 post	74.70	8.80	17.79	2.77	205.18	32.34	0.25	0.03
C3 pre	47.43	6.27	12.43	1.91	361.16	81.04	0.30	0.06
C3 post	76.61	7.03	18.14	2.73	218.73	23.12	0.25	0.03
C4 pre	33.52	4.35	9.10	1.35	178.93	25.63	0.27	0.03
C4 post	90.23	14.35	22.53	3.58	230.38	33.17	0.27	0.04
C5 pre	36.21	3.49	10.46	1.82	201.82	18.70	0.28	0.04
C5 post	88.15	10.00	20.83	2.78	204.86	14.32	0.25	0.03

Norepinephrine (ng/min)

Subject #	Cond 1 pre	Cond 1 post	Cond 2 pre	Cond 2 post	Cond 3 pre	Cond 3 post	Cond 4 pre	Cond 4 post	Cond 5 pre	Cond 5 post
1	57.62	94.03	66.75	77.96	45.07	113.10	47.27	73.83	58.70	96.71
2	44.46	136.92	58.12	127.65	61.32	97.46	49.23	87.28	47.51	135.37
4	43.34	124.44	38.95	124.30	20.92	111.98	11.18	119.69	39.49	115.55
5	80.70	81.12	21.26	75.42	97.68	45.63	42.31	89.14	20.65	73.71
6	26.22	53.02	46.35	56.41	31.36	100.57	50.15	236.28	26.67	63.49
7	17.29	56.29	33.68	72.30	38.60	42.83	40.82	103.52	23.14	93.69
8	11.14	52.51	36.81	50.97	52.50	59.58	44.08	37.40	29.62	141.66
9	.	52.23	32.91	24.23	16.38	54.33	20.49	35.85	27.11	35.40
11	54.29	82.71	24.65	68.54	34.99	88.78	43.20	104.84	45.47	103.76
12	59.99	66.44	62.62	41.97	63.36	83.54	19.85	101.65	18.45	21.70
13	53.62	85.73	36.48	89.31	34.63	67.85	12.63	79.06	46.93	i01.01
14	48.01	36.80	32.64	87.39	44.10	83.61	.	65.62	44.22	106.06
15	50.08	40.73	.	.	75.72	46.61	21.12	38.87	42.71	57.86

Table 14 (cont.)

Dopamine (ng/min)

Subject #	Cond 1 pre	Cond 1 post	Cond 2 pre	Cond 2 post	Cond 3 pre	Cond 3 post	Cond 4 pre	Cond 4 post	Cond 5 pre	Cond 5 post
1	147.46	159.58	319.05	185.21	151.31	325.22	289.00	.	276.29	249.08
2	121.08	120.86	72.23	120.74	167.79	136.74	126.12	51.98	73.94	139.77
4	111.41	240.63	244.44	354.08	429.75	265.03	30.72	424.04	.	198.59
5	.	156.84	177.91	184.98	912.13	125.40	175.07	143.59	138.65	260.39
6	386.06	256.26	203.03	220.02	.	.	.	268.45	274.70	189.59
7	113.66	183.48	.	199.92	333.37	198.04	279.30	361.41	202.47	176.70
8	91.57	228.99	168.65	149.19	237.79	227.57	.	103.48	208.57	.
9	.	.	116.88	.	221.22	133.99	175.71	167.19	234.99	185.45
11	286.86	258.35	93.66	70.58	144.07	167.69	231.69	223.58	232.11	248.66
12	144.47	254.95	197.37	67.62	.	344.39	114.80	300.96	162.65	120.51
13	190.06	221.06	234.95	327.47	438.52	261.83	132.44	242.42	281.54	242.54
14	369.54	157.52	199.62	377.19	135.96	302.15	.	247.06	204.69	242.18
15	697.96	209.75	.	.	800.86	136.73	234.41	.	131.24	.

Epinephrine (ng/min)

Subject #	Cond 1 pre	Cond 1 post	Cond 2 pre	Cond 2 post	Cond 3 pre	Cond 3 post	Cond 4 pre	Cond 4 post	Cond 5 pre	Cond 5 post
1	25.41	28.88	20.36	39.53	14.52	16.63	15.57	25.46	11.72	21.28
2	10.96	21.21	14.58	19.95	17.92	42.59	9.44	27.76	15.10	19.73
4	13.90	44.71	6.90	26.05	10.16	30.60	2.59	30.63	6.08	34.35
5	19.52	21.91	4.01	20.10	13.02	10.57	10.08	35.57	2.13	14.88
6	10.18	9.84	12.20	18.57	28.52	19.33	14.76	24.71	10.79	17.40
7	4.06	16.81	9.68	24.47	6.63	8.27	13.47	42.02	5.37	40.50
8	3.81	9.75	9.75	7.39	6.38	11.75	13.15	4.21	2.05	23.55
9	.	11.20	6.88	9.28	5.17	13.44	5.32	12.24	10.95	14.08
11	7.43	8.78	4.55	8.37	5.83	7.06	6.81	10.14	11.21	10.13
12	15.77	13.58	6.96	7.07	10.29	16.41	3.83	42.02	2.54	4.71
13	6.22	16.46	13.45	20.13	8.21	15.23	3.07	7.13	19.70	32.70
14	12.41	6.42	2.57	12.52	13.40	18.68	.	19.47	17.16	16.62
15	14.92	18.61	.	.	21.54	25.24	11.10	11.52	21.17	20.84

Table 15

Urine flow (ml/min)

subject	C1 pre	C1 post	C2 pre	C2 post	C3 pre	C3 post	C4 pre	C4 pre	C5 pre	C5 post
1	0.51	1.00	0.78	1.19	0.83	0.82	0.93	1.11	1.23	1.32
2	0.45	1.54	0.21	1.12	0.42	1.70	0.23	1.11	0.35	0.68
4	1.06	0.41	0.61	0.56	2.04	1.03	2.14	0.31	1.01	0.52
5	0.80	0.71	0.88	0.59	0.57	0.83	0.23	0.65	0.50	0.36
6	1.17	1.46	1.01	1.02	1.90	0.94	0.93	0.86	0.55	0.91
7	0.63	1.30	0.75	1.08	0.57	2.26	0.73	0.68	0.52	0.64
8	0.50	0.64	0.43	1.09	0.34	0.35	2.02	0.53	0.76	0.63
9	2.38	0.48	•	•	2.72	0.87	4.05	1.97	1.88	0.60
11	0.50	0.66	0.82	0.52	0.72	0.41	1.41	0.7	0.65	0.83
12	2.84	0.94	2.25	0.77	2.17	0.63	1.56	0.52	0.89	0.55
13	2.06	1.00	2.42	1.59	2.04	1.38	0.88	0.88	1.15	1.09
14	0.82	1.71	1.47	0.93	0.45	0.73	0.53	1.02	0.72	1.20
15	0.60	1.14	1.29	1.55	2.55	1.45	1.94	1.89	3.21	1.14

Subject #	%ΔC1	%ΔC2	%ΔC3	%ΔC4	%ΔC5
1	106.35	44.00	74.78	-6.85	23.08
2	-66.90	-65.78	-244.44	-66.67	-38.20
4	242.22	433.33	75.29	382.61	94.29
5	24.79	0.99	-102.13	-7.53	65.45
6	-51.46	-34.30	-47.83	0.00	-5.22
7	96.08	52.56	-1.22	19.35	7.32
8	108.54	-36.73	38.36	92.45	66.67
9	32.00	-36.59	-75.61	-50.35	27.69
11	-61.32	-8.20	-98.06	-85.51	-48.51
12	-11.25	-32.95	31.33	182.61	-28.00
13	90.00	20.16	-75.86	-2.58	-64.49
14	28.00	153.49	2.86	-73.76	-17.11
15	-79.83	•	-212.64	-51.36	-68.09

% Δ Urine flow (ml/min)

Condition	mean	s.e.m.
1	35.17	25.67
2	40.83	37.93
3	-48.86	27.90
4	25.57	36.04
5	1.15	14.47

Table 16

Subject 1

cond 1

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	12.5	17.5	18.75	13.75	21.25	32.5	37.5	31.25	30	52.5	21.25	33.75	40	36.25	32.5	35	35
2	21.25	26.25	23.75	32.5	25	22.5	23.75	22.5	17.5	46.75	15	21.25	17.5	23.75	20	18.75	22.5
3	18.75	8.75	41.25	51.25	22.5	27.5	35	22.5	12.5	11.25	8.75	68.75	23.75	11.25	12.5	11.25	10
4	11.25	11.25	12.5	13.75	13.75	13.75	15	15	12.5	25	12.5	21.25	16.25	13.75	16.25	15	15
5	11.25	8.75	10	10	11.25	27.5	36.25	23.75	12.5	40	28.75	35	15	27.5	26.25	18.75	51.25
6	12.5	8.75	13.75	10	10	12.5	12.5	20	16.25	23.75	16.25	26.25	20	18.75	20	21.25	16.25
	14.58	13.54	20.00	21.88	17.29	22.71	26.67	22.50	16.88	33.54	17.08	34.38	22.08	21.88	21.25	20.00	25.00

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	11.25	11.25	11.25	11.25	12.5	11.25	12.5	12.5	12.5	10	12.5	12.5	12.5	12.5	10	13.75	12.5
2	13.75	13.75	15	16.25	18.75	23.75	23.75	32.5	21.25	28.75	17.5	30	17.5	28.75	25	26.25	20
3	12.5	11.25	12.5	12.5	13.75	15	15	21.25	18.75	31.25	13.75	16.25	13.75	18.75	18.75	30	13.75
4	16.25	13.75	16.25	15	16.25	21.25	18.75	21.25	17.5	18.75	16.25	17.5	17.5	18.75	23.75	27.5	18.75
5	12.5	11.25	12.5	11.25	13.75	16.25	17.5	36.25	21.25	38.75	35	38.75	33.75	33.75	35	36.25	13.75
6	16.25	13.75	17.5	17.5	16.25	18.75	21.25	33.75	28.75	38.75	22.5	31.25	23.75	33.75	30	31.25	16.25
	13.75	12.50	14.17	13.96	15.21	17.71	18.13	26.25	20.00	27.71	19.58	24.38	19.79	24.38	23.75	27.50	15.83

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	10	11.25	11.25	11.25	11.25	15	15	25	15	25	21.25	25	21.25	30	28.75	27.5	17.5
2	15	22.5	18.75	21.25	22.5	25	25	30	35	37.5	32.5	36.25	37.5	36.25	32.5	36.25	25
3	11.25	18.75	11.25	11.25	18.75	15	35	12.5	13.75	13.75	12.5	20	16.25	27.5	26.25	16.25	41.25
4	16.25	20	16.25	18.75	21.25	26.25	36.25	33.75	27.5	28.75	28.75	35	23.75	42.5	35	32.5	33.75
5	11.25	15	12.5	15	12.5	22.5	32.5	27.5	22.5	22.5	25	20	15	26.25	23.75	28.75	28.75
6	12.5	13.75	13.75	12.5	13.75	13.75	15	11.25	13.75	13.75	13.75	16.25	13.75	22.5	27.5	18.75	15
	12.71	16.88	13.96	15.00	16.67	19.58	26.46	23.33	21.25	23.54	22.29	25.42	21.25	30.83	28.96	26.67	26.88

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	12.5	¥	13.75	¥	22.5	45	27.5	31.25	50	42.5	18.75	40	45	32.5	41.25	40	32.5
2	25	¥	27.5	¥	30	42.5	31.25	23.75	22.5	26.25	17.5	26.25	26.25	22.5	22.5	27.5	28.75
3	15	¥	15	¥	21.25	52.5	23.75	16.25	25	12.5	13.75	13.75	18.75	16	18.75	13.75	20
4	17.5	¥	18.75	¥	18.75	26.25	25	21.25	18.75	20	18.75	20	22.5	20	22.5	18.75	23.75
5	12.5	¥	13.75	¥	13.75	15	25	36.25	27.5	40	41.25	26.25	33.75	33.75	36.25	25	31.25
6	12.5	¥	13.75	¥	13.75	17.5	21.25	27.5	17.5	27.5	22.5	32.5	30	25	30	31.25	20
	15.83		17.08		20.00	33.13	25.63	26.04	26.88	28.13	22.08	26.46	29.38	24.79	28.54	26.04	26.04

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	37.5	¥	20	¥	22.5	58.75	23.75	40	33.75	32.5	31.25	46.25	22.5	41.25	48.75	30	35
2	27.5	¥	21.25	¥	30	38.75	25	26.25	17.5	25	20	30	18.75	32.5	32.5	27.5	23.75
3	21.25	¥	12.5	¥	16.25	31.25	13.75	21.25	12.5	13.75	15	23.75	11.25	20	21.25	13.75	22.5
4	18.75	¥	16.25	¥	26.25	17.5	16.25	18.75	16.25	20	22.5	22.5	16.25	26.25	23.75	22.5	18.75
5	32.5	¥	23.75	¥	11.25	41.25	36.25	50	30	41.25	43.75	40	46.25	48.75	41.25	48.75	36.25
6	12.5	¥	12.5	¥	11.25	15	16.25	17.5	12.5	21.25	16.25	18.75	13.75	21.25	31.25	33.75	13.75
	25.00		17.71		19.58	33.75	21.88	29.96	20.42	25.63	24.79	30.21	21.46	31.67	33.13	29.38	25.00

¥ EMG data was not recorded during exercise

Table 16 (cont.)

Subject 2

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	28.75	31.25	25	37.5	30	56.25	48.75	63.75	25	63.75	33.75	52.5	25	63.75	52.5	85	50
2	15	26.25	16.25	31.25	23.75	62.5	25	32.5	12.5	32.5	12.5	27.5	16.25	35	23.75	35	26.25
3	8.75	10	10	12.5	12.5	20	20	21.25	23.75	12.5	10	17.5	11.25	13.75	12.5	20	13.75
4	17.5	20	22.5	15	15	23.75	21.25	27.5	17.5	22.5	17.5	30	20	26.25	22.5	25	20
5	10	12.5	15	11.25	16.25	25	21.25	30	12.5	26.25	12.5	25	18.75	30	22.5	36.25	16.25
6	8.75	10	10	10	10	12.5	11.25	17.5	11.25	17.5	11.25	16.25	12.5	18.75	16.25	20	10
	14.79	18.33	16.46	19.58	17.92	15.00	24.58	32.08	17.08	29.17	16.25	28.13	17.29	31.25	25.00	36.88	22.71

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	13.75	23.75	25	30	36.25	47.5	57.5	65	13.75	47.5	26.25	51.25	25	62.5	56.25	65	53.75
2	11.25	12.5	13.75	15	15	30	33.75	31.25	13.75	33.75	13.75	26.25	16.25	37.5	33.75	40	35
3	10	10	10	10	10	13.75	15	11.25	17.5	13.75	11.25	11.25	8.75	12.5	13.75	11.25	13.75
4	13.75	13.75	15	15	13.75	20	20	16.25	15	17.5	13.75	13.75	13.75	16.25	17.5	16.25	26.25
5	10	12.5	13.75	16.25	17.5	16.25	18.75	30	12.5	33.75	13.75	25	15	28.75	35	22.5	163.8
6	10	10	10	11.25	10	10	10	10	11.25	11.25	11.25	10	10	10	11.25	10	13.75
	11.46	13.75	14.58	16.25	17.08	22.92	25.83	27.29	13.96	26.25	15.00	22.92	14.79	27.92	27.92	27.50	51.04

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	11.25	13.75	13.75	11.25	12.5	13.75	13.75	11.25	12.5	12.5	12.5	11.25	15	13.75	13.75	13.75	12.5
2	38.75	35	32.5	43.75	53.75	43.75	51.25	57.5	28.75	52.5	26.25	76.25	27.5	66.25	62.5	41.25	58.75
3	15	16.25	17.5	13.75	15	17.5	20	17.5	23.75	17.5	16.25	17.5	18.75	25	21.25	20	17.5
4	16.25	22.5	20	18.75	25	20	23.75	20	17.5	18.75	17.5	33.73	22.5	33.75	23.75	20	27.5
5	17.5	15	17.5	15	16.25	22.5	20	21.25	17.5	18.75	16.25	33.75	18.75	38.25	25	20	20
6	12.5	13.75	15	12.5	15	13.75	13.75	21.25	13.75	18.75	18.75	23.75	17.5	25	22.5	21.25	15
	18.54	19.38	19.38	19.17	22.92	21.88	23.75	24.70	18.96	23.13	17.92	32.71	20.00	36.67	28.46	22.71	25.21

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	20	✘	18.75	✘	17.5	45	48.75	45	27.5	53.75	31.25	45	51.25	55	58.75	60	51.25
2	12.5	✘	12.5	✘	11.25	27.5	27.5	30	17.5	40	13.75	28.75	38.75	30	27.5	42.5	37.5
3	10	✘	10	✘	11.25	12.5	12.5	12.5	28.75	18.75	11.25	12.5	15	15	31.25	20	12.5
4	17.5	✘	18.75	✘	16.25	23.75	23.75	21.25	16.25	32.5	15	22.5	22.5	21.25	? ?	23.75	26.25
5	11.25	✘	12.5	✘	11.25	18.75	22.5	27.5	12.5	37.5	12.5	23.75	25	28.75	22.5	25	18.75
6	10	✘	11.25	✘	11.25	13.75	13.75	18.75	13.75	21.25	13.75	20	16.25	20	15	18.75	12.5
	13.54		13.96		13.13	23.54	24.79	25.83	19.38	33.96	16.25	25.42	28.13	28.33	29.17	31.67	26.46

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	31.25	✘	26.25	✘	21.25	56.25	47.5	63.75	40	103.8	37.5	93.75	46.25	83.75	83.75	76.25	53.75
2	13.75	✘	13.75	✘	12.5	28.75	25	35	16.25	45	16.25	33.75	20	42.5	38.75	40	27.5
3	17.5	✘	15	✘	12.5	31.25	16.25	16.25	26.25	22.5	15	17.5	15	16.25	20	16.25	13.75
4	20	✘	20	✘	18.75	23.75	25	23.75	16.25	20	17.5	20	23.75	23.75	21.25	28.75	25
5	43.75	✘	48.75	✘	30	28.75	55	47.5	52.5	57.5	42.5	35	53.75	60	61.25	51.25	51.25
6	10	✘	11.25	✘	12.5	11.25	15	25	11.25	20	12.5	20	17.5	23.75	22.5	13.75	12.5
	22.71		22.50		17.92	30.00	30.83	35.21	27.08	44.79	23.54	36.67	29.38	41.67	41.25	37.71	30.83

✘ EMG data was not recorded during exercise

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Table 16 (cont.)

Subject 4

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	20	8.75	11.25	11.25	8.75	11.25	10	11.25	10	10	11.25	11.25	11.25	10	13.75	11.25	10
2	23.75	16.25	11.25	11.25	10	10	10	11.25	8.75	10	11.25	11.25	11.25	10	13.75	10	8.75
3	28.75	20	11.25	11.25	8.75	15	12.5	12.5	33.75	10	11.25	12.5	11.25	15	16.25	17.5	10
4	28.75	12.5	15-	15	13.75	17.5	18.75	20	13.75	18.75	16.25	36.25	16.25	22.5	20	20	12.5
5	21.25	8.75	11.25	11.25	10	18.75	21.25	26.25	20	27.5	26.25	33.75	12.5	27.5	18.75	28.75	12.5
6	21.25	8.75	11.25	11.25	8.75	11.25	10	12.5	10	20	12.5	12.5	12.5	11.25	13.75	11.25	10
	23.96	12.50	11.88	11.88	10.00	13.96	13.75	15.63	16.04	16.04	14.79	19.58	12.50	16.04	16.04	16.46	10.63

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	35	28.75	20	35	23.75	70	66.25	83.75	72.5	86.25	12.5	73.75	18.75	76.25	77.5	71.25	47.5
2	15	15	16.25	15	15	28.75	30	38.75	25	32.5	15.25	27.5	15	37.5	21.25	25	15
3	11.25	12.5	11.25	12.5	11.25	12.5	13.75	12.5	18.75	17.5	11.25	12.5	11.25	13.75	11.25	13.75	11.25
4	15	17.5	26.25	17.5	16.25	16.25	17.5	18.75	17.5	20	15	17.5	16.25	18.75	16.25	18.75	15
5	12.5	12.5	12.5	12.5	13.75	15	16.25	53.75	37.5	50	22.5	91.25	30	58.75	45	113.8	15
6	11.25	18.75	17.5	17.5	16.25	20	20	23.75	17.5	21.25	16.25	25	16.25	26.25	18.75	30	20
	16.67	17.50	17.29	18.33	16.04	27.08	27.29	38.54	31.46	37.92	15.63	41.25	17.92	38.54	31.67	45.42	20.63

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	15	17.5	21.25	20	17.5	48.75	36.25	91.25	42.5	55	18.75	66.25	31.25	71.25	65	75	40
2	15	15	17.5	16.25	18.75	33.75	28.75	52.5	18.75	45	22.5	61.25	23.75	37.5	31.25	43.75	28.75
3	12.5	12.5	13.75	12.5	16.25	21.25	18.75	28.75	22.5	31.25	12.5	36.75	12.5	16.25	11.25	25	15
4	17.5	17.5	18.75	18.75	21.25	31.25	30	35	17.5	28.75	17.5	46.25	16.25	18.75	16.25	33.75	23.75
5	13.75	15	18.75	15	15	20	20	43.75	23.75	37.5	33.75	46.75	23.75	42.5	36.25	37.5	20
6	12.5	12.5	13.75	13.75	13.75	37.5	22.5	25	15	26.25	13.75	22.5	18.75	25	32.5	22.5	27.5
	14.38	15.00	17.29	16.04	17.08	32.08	26.04	46.04	23.33	37.29	19.79	52.29	21.04	35.21	32.08	39.58	25.83

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	18.75	¥	11.25	¥	11.25	68.75	92.5	82.5	55	68.75	12.5	80	31.25	82.5	88.25	71.25	62.5
2	13.75	¥	15	¥	13.75	22.5	46.25	47.5	18.75	27.5	16.25	37.5	15	38.25	38.25	46.25	18.75
3	8.75	¥	10	¥	10	17.5	36.75	18.75	20	15	11.25	13.75	11.25	15	13.75	16.25	13.75
4	12.5	¥	17.5	¥	13.75	17.5	31.25	27.5	15	30	15	33.75	15	27.5	22.5	31.25	17.5
5	8.75	¥	10	¥	10	17.5	36	31.25	15	37.5	22.5	40	12.5	36	38.25	41.25	15
6	0.75	¥	10	¥	10	12.5	16.25	17.5	13.75	15	11.25	15	12.5	12.5	13.75	16.25	16.25
	11.88		12.29		11.46	26.04	43.33	37.50	22.92	32.29	14.79	36.67	16.25	34.79	34.79	37.08	23.96

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	23.75	¥	28.25	¥	23.75	90	65	92.5	71.25	77.5	18.75	81.25	57.5	97.5	67.5	67.5	51.25
2	12.5	¥	13.75	¥	13.75	37.5	27.5	35	22.5	36.25	15	37.5	16.25	50	23.75	25	15
3	11.25	¥	11.25	¥	12.5	16.25	13.75	18.75	18.75	22.5	12.5	20	18.75	36.25	17.5	13.75	12.5
4	13.75	¥	15	¥	16.25	23.75	16.25	22.5	15	22.5	16.25	18.75	21.25	36.75	18.75	18.75	16.25
5	10	¥	11.25	¥	12.5	13.75	16.25	66.25	35	46.25	30	41.25	25	36.75	33.75	36.25	13.75
6	11.25	¥	11.25	¥	12.5	12.5	12.5	15	12.5	15	12.5	13.75	13.75	26.25	17.5	18.75	12.5
	13.75		14.79		15.21	32.29	25.21	41.67	29.17	36.67	17.50	38.42	25.42	47.92	29.79	30.00	20.21

¥ EMG data was not recorded during exercise

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Table 16 (cont.)

Subject 6

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	31.25	27.5	30	66.25	48.75	68.25	92.5	93.75	80	77.5	33.75	51.25	43.75	126.3	52.5	58.75	80
2	13.75	12.5	13.75	16.25	17.5	25	23.75	33.75	18.75	27.5	16.25	26.25	15	32.5	22.5	22.5	23.75
3	12.5	12.5	12.5	11.25	12.5	13.75	12.5	35	31.25	21.25	15	17.5	17.5	36.25	13.75	17.5	11.25
4	17.5	15	16.25	16.25	16.25	20	17.5	23.75	16.25	20	16.25	20	17.5	22.5	16.25	16.25	16.25
5	12.5	11.25	12.5	16.25	16.25	23.75	18.75	47.5	12.5	28.75	23.75	35	33.75	43.75	31.25	33.75	16.25
6	12.5	12.5	12.5	11.25	12.5	13.75	12.5	28.75	13.75	33.75	12.5	31.25	30	27.5	27.5	18.75	11.25
	16.67	15.21	16.25	22.92	20.63	27.04	29.58	43.75	28.75	34.79	19.58	30.21	26.25	48.13	27.29	27.92	26.46

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	40	40	51.25	57.5	66.25	126.3	127.5	97.5	80	107.5	46.25	122.5	62.5	162.5	97.5	127.5	97.5
2	10	10	11.25	12.5	17.5	38.75	30	27.5	18.75	25	20	33.75	22.5	45	26.25	32.5	32.5
3	8.75	10	10	8.75	11.25	26.25	16.25	26.25	23.75	26.25	13.75	26.25	17.5	45	35	23.73	18.75
4	12.5	12.5	13.75	12.5	13.75	50	47.5	48.75	46.25	48.75	45	48.75	47.5	60	53.75	50	51.25
5	10	10	11.25	10	17.5	28.75	27.5	35	26.25	40	37.5	35	40	50	40	38.75	33.75
6	10	10	11.25	10	11.25	28.75	23.75	36.25	30	32.5	26.25	35	31.25	41.25	40	32.5	26.25
	15.21	15.42	18.13	18.54	21.25	49.79	45.42	45.21	37.50	46.67	31.46	50.21	36.88	67.29	48.75	50.83	43.33

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	55	*	98.75	*	83.75	98.75	100	125	111.3	113.8	40	116.3	47.5	95	76.25	120	130
2	15	*	28.75	*	26.25	30	31.25	32.5	28.75	22.5	16.25	35	21.25	26.25	16.25	31.25	23.75
3	12.5	*	47.5	*	15	18.75	35	30	25	17.5	12.5	27.5	13.75	23.75	23.75	22.5	13.75
4	18.75	*	23.75	*	18.75	22.5	25	26.25	21.25	20	17.5	22.5	20	13.75	17.5	20	18.75
5	13.75	*	12.5	*	13.75	25	20	27.5	31.25	31.25	13.75	25	28.75	25	17.5	26.25	13.75
6	13.75	*	16.25	*	17.5	21.25	26.25	20	16.75	15	16.25	20	28.75	18.75	13.75	17.5	13.75
	21.46		37.92		29.17	36.04	39.58	43.54	39.38	36.67	19.38	41.04	26.67	34.58	27.50	39.58	35.63

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	23.75	¥	11.25	¥	12.5	16.25	68.75	75	61.25	57.5	16.25	37.5	16.25	43.75	32.5	43.75	53.75
2	16.25	¥	11.25	¥	12.5	12.5	12.5	12.5	10	11.25	10	12.5	11.25	11.25	12.5	11.25	10
3	28.75	¥	25	¥	26.25	31.25	35	40	35	32.5	26.25	33.75	27.5	32.5	32.5	36.25	28.75
4	16.25	¥	12.5	¥	15	12.5	20	17.5	13.75	17.5	13.75	22.5	16.25	18.75	22.5	22.5	13.75
5	22.5	¥	8.75	¥	11.25	10	30	52.5	36.25	53.75	12.5	55	55	61.25	53.75	45	20
6	16.25	¥	8.75	¥	11.25	10	16.25	20	18.75	20	11.25	23.75	15	18.75	17.5	18.75	12.5
	20.63		12.92		14.79	15.42	30.42	36.25	29.17	32.08	15.00	30.83	23.54	31.04	28.54	29.58	23.13

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	40	¥	67.5	¥	46.25	122.5	121.3	91.25	92.5	97.5	33.75	73.75	42.5	142.5	105	115	102.5
2	20	¥	21.25	¥	27.5	26.25	33.75	28.75	16.25	25	15	25	13.75	30	17.5	25	25
3	13.75	¥	17.5	¥	13.75	28.75	31.25	33.75	28.75	33.75	26.25	37.5	22.5	27.5	26.25	33.75	15
4	21.25	¥	23.75	¥	26.25	30	33.75	28.75	23.75	26.25	25	30	25	32.5	26.25	21.25	30
5	15	¥	13.75	¥	12.5	22.5	31.25	21.25	13.75	23.75	16.25	25	20	25	22.5	17.5	31.25
6	12.5	¥	13.75	¥	12.5	18.75	26.25	20	18.75	20	13.75	20	16.25	26.25	17.5	20	13.75
	20.42		24.58		23.13	41.46	46.25	37.29	32.29	37.71	21.67	35.21	23.33	47.29	35.83	38.75	36.25

¥ EMG data was not recorded during exercise   * data lost due to technical problems

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Table 16 (cont.)

Subject 6

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	73.75	86.25	0	102.5	120	95	113.8	107.5	115	165	38.75	98.75	95	120	102.5	106.3	121.3
2	27.5	31.25	28.75	*	20	28.75	37.5	41.25	22.5	50	17.5	45	40	40	23.75	57.5	41.25
3	12.5	18.75	10	28.75	53.75	13.75	13.75	25	25	55	12.5	16.25	12.5	13.75	36.25	13.75	15
4	16.25	16.25	15	23.75	20	18.75	20	41.25	16.25	55	16.25	22.5	17.5	26.25	17.5	21.25	21.25
5	16.25	13.75	12.5	13.75	16.25	21.25	15	98.75	33.75	120	8.75	72.5	73.75	66.25	66.25	55	21.25
6	12.5	16.25	11.25	13.75	16.25	12.5	11.25	18.75	12.5	27.5	15	17.5	17.5	17.5	17.5	20	12.5
7	17.5	17.5	18.75	17.5	20	16.25	20	28.75	21.25	41.25	17.5	23.75	17.5	26.25	20	23.75	15
	25.18	28.57	13.75	28.57	38.04	29.46	33.04	51.61	35.18	73.39	18.04	42.32	39.11	42.86	40.54	42.50	35.36

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	.	.	.	.	.	.	>	.	.	.	.	.	.	.	.	.	.
5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	57.5	63.75	65	57.5	92.5	150	137.5	66.25	68.75	85	46.25	65	121.3	51.25	76.25	82.5	120
2	10	10	10	13.75	16.25	35	38.75	30	17.5	23.75	21.25	25	17.5	22.5	25	25	27.5
3	10	10	10	11.25	11.25	17.5	38.75	12.5	12.5	11.25	11.25	12.5	28.25	12.5	12.5	12.5	13.75
4	12.5	13.75	13.75	15	15	22.5	32.5	17.5	16.25	15	15	16.25	17.5	15	15	17.5	15
5	11.25	11.25	11.25	11.25	15	41.25	16.25	51.25	52.5	37.5	32.5	48.75	32.5	53.75	51.25	46.25	18.75
6	11.25	12.5	11.25	15	22.5	18.75	53.75	47.5	20	43.75	45	46.25	20	47.5	46.25	46.25	41.25
7	12.5	12.5	13.75	101.3	11.25	11.25	12.5	11.25	12.5	11.25	11.25	11.25	13.75	11.25	10	13.75	12.5
	17.86	19.11	19.29	32.14	26.25	42.32	42.86	33.75	28.57	32.50	26.07	32.14	35.54	30.54	33.75	34.82	35.54

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	60	¥	35	¥	58.75	90	76.25	62.5	58.75	41.25	35	36.25	20	67.5	51.25	50	70
2	18.75	¥	13.75	¥	12.5	18.75	18.75	28.75	16.25	20	15	16.25	16.25	15	16.25	18.75	18.75
3	18.75	¥	11.25	¥	11.25	12.5	13.75	20	23.75	22.5	16.25	15	10	33.75	13.75	16.25	12.5
4	13.75	¥	15	¥	12.5	13.75	16.25	32.5	15	17.5	18.75	17.5	13.75	15	17.5	17.5	16.25
5	11.25	¥	15	¥	10	16.25	36.25	87.5	40	63.75	45	45	21.25	18.75	48.75	63.75	20
6	11.25	¥	11.25	¥	10	10	11.25	21.25	16.25	13.75	15	17.5	13.75	13.75	15	15	11.75
7	10	¥	10	¥	8.75	8.75	10	16.25	23.75	18.75	18.75	21.25	21.25	23.75	22.5	20	11.25
	20.54		15.89		17.68	24.29	26.07	38.39	27.68	28.21	23.39	24.11	16.61	25.79	26.43	28.75	23.21

cond 5	12	24	.		.	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	62.5	¥	4.		30	46.25	76.25	0	0	0	0	0	0	0	0	0	65
2	16.25	¥	1		9.25	31.25	38.75	56.25	68.75	75	46.75	75	42.5	56.25	112.5	116.3	60
3	21.25	¥			12.5	12.5	17.5	37.5	25	16.25	15	37.5	13.75	18.75	18.75	11.25	17.5
4	17.5	¥	15..0	¥	18.75	18.75	20	23.75	23.75	25	21.25	66.25	20	26.25	22.5	21.25	18.75
5	13.75	¥	16.25	¥	13.75	15	25	56.25	36.25	61.25	53.75	81.25	42.5	62.5	50	26.25	21.25
6	12.5	¥	15	¥	13.75	13.75	12.5	17.5	23.75	21.25	15	23.75	15	16.25	22.5	20	13.75
7	11.25	¥	12.5	¥	12.5	12.5	12.5	26.25	26.25	28.75	25	26.25	23.75	35	22.5	21.25	12.5
	22.14		18.75		18.64	21.43	28.93	31.07	29.11	32.50	25.54	44.29	22.50	29.29	35.54	30.89	29.82

¥ EMG data was not recorded during exercise   * data lost due to technical problems

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Table 16 (cont.)

Subject 7

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	17.5	*	20.0	38.0	22.5	52.5	47.5	45.0	26.3	48.8	13.8	46.3	15.0	37.5	32.5	31 3	46 3
2	16.3	*	21.3	20.0	21.3	23.8	17.5	21.3	13.8	27.5	13.8	22.5	13.8	21.3	15.0	17 5	15.0
3	28.8	*	37.5	20.0	13.8	17.5	13.8	13.8	16.3	15.0	12.5	17.5	13.8	13.8	13.8	13.8	12 5
4	17.5	*	20.0	28.8	28.8	25.0	17.5	17.5	17.5	23.8	16.3	23.8	18.8	18.8	17.5	20 0	16 3
5	12.5	*	18.8	22.5	11.3	18.8	13.8	23.8	2.5	25.0	23.8	30.0	15.0	25.0	20.0	21 3	13 8
6	11.3	*	17.5	17.5	11.3	12.5	12.5	17.5	20.0	13.8	13.8	18.8	17.5	15.0	17.5	15 0	12 5
7	1.3	*	27.5	40.0	10.0	11.3	11.3	11.3	12.5	11.3	11.3	11.3	13.8	11.3	12.5	11 3	11 3
	15.0		23.2	26.3	17.0	23.0	19.1	21.4	15.5	23.8	15.0	24.3	15.4	20.4	18.4	18.6	18.2

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	20.0	30.0	32.5	35.0	68.8	113.8	101.3	108.8	45.0	97.5	16.3	105.0	42.5	131.3	95.0	140 0	75 0
2	30.0	*	*	41.3	103.8	80.0	77.5	60.0	15.0	65.0	12.5	65.0	21.3	97.5	26.3	151 3	18 8
3	26.3	68.8	25.0	21.3	26.3	12.5	12.5	43.8	61.3	71.3	21.3	48.8	23.8	70.0	43.8	135 0	16 3
4	17.5	22.5	25.0	21.3	28.8	80.0	58.8	45.0	20.0	53.8	27.5	47.5	27.5	52.5	28.8	127 5	26 3
5	12.5	13.8	11.3	11.3	12.5	13.8	11.3	42.5	27.5	42.5	40.0	48.8	25.0	42.5	36.3	67 5	12 5
6	12.5	13.8	12.5	12.5	11.3	15.0	12.5	28.8	31.3	27.5	16.3	31.3	28.8	26.3	30.0	37 5	12 5
7	11.3	10.0	11.3	11.3	11.3	10.0	10.0	10.0	10.0	10.0	10.0	12.5	13.8	10.0	13.8	11 3	11 3
	18.6	18.6	18.6	22.0	37.5	46.4	40.5	48.4	30.0	52.5	20.5	5?.3	26.1	61.4	39.1	95.7	24.6

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	48.8	28.8	107.5	56.3	80.0	162.5	195.0	142.5	70.0	152.5	37.5	123.8	93.8	166.3	0.0	113 8	122 5
2	23.8	22.5	48.3	41.3	75.0	53.8	62.5	45.0	13.3	62.5	17.5	55.0	27.5	55.0	0.0	25 0	30 0
3	27.5	22.5	33.8	26.3	40.0	18.8	18.8	16.3	23.8	21.3	11.3	18.8	15.0	15.0	0.0	13 8	18 8
4	32.5	31.3	38.8	42.5	36.3	45.0	36.3	26.3	16.3	41.3	17.5	31.3	25.0	35.0	0.0	20.0	21 3
5	25.0	22.5	26.3	25.0	23.8	18.8	13.8	56.3	21.3	50.0	17.5	47.5	41.3	40.0	0.0	37 5	12 5
6	23.8	21.3	25.0	25.0	23.8	13.8	12.5	20.0	18.8	21.3	16.3	26.3	25.0	25.0	0.0	18 8	12 5
7	31.3	20.0	25.0	22.5	22.5	12.5	11.3	10.0	11.3	11.3	21.3	12.5	11.3	10.0	0 0	12 5	11 3
	30.4	24.1	43.8	34.1	43.0	46.4	50.0	45.2	25.0	51.4	19.8	45.0	34.1	49.5	0.0	34.5	32.7

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	16.3	¥	11.3	¥	12.5	36.3	42.5	102.5	43.8	65.0	43.8	88.8	12.5	130.0	36.3	93 8	93 8
2	12.5	¥	15.0	¥	13.8	33.8	22.5	67.5	15.0	56.3	15.0	68.8	16.3	88.8	21.3	50 0	28 8
3	10.0	¥	12.5	¥	10.0	30.0	13.8	27.5	40.0	46.0	40.0	42.5	10.0	46.3	13.8	30 0	90 0
4	13.8	¥	13.3	¥	13.8	35.0	18.8	47.5	15.0	61.3	15.0	62.5	13.8	67.5	17.5	41 3	28 8
5	10.0	¥	10.0	¥	10.0	16.3	12.5	40.0	23.8	60.0	21.3	50.0	20.0	47.5	36.3	48 8	22 5
6	10.0	¥	10.0	¥	10.0	13.8	11.3	42.5	27.5	40.0	27.5	38.8	47.5	43.8	31.3	47 5	11 3
7	8.8	¥	10.0	¥	10.0	11.3	8.8	16.3	10 0	8.8	10.0	10.0	10.0	16.3	10.0	11 3	8 8
	11.6		11.6		11.4	25.2	18.5	49.1	25.0	50.9	24.6	51.6	18.6	62.0	23.8	46.1	40 5

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	23.8	¥	21.3	¥	21.3	111.3	83.8	63.8	63.8	61.3	22.5	83.8	21.3	88.8	76.0	81 3	65 0
2	16.3	¥	15.0	¥	15.0	53.8	41.3	48.8	16.3	28.8	17.5	46.0	16.3	41.3	25.3	58 8	47 5
3	15.0	¥	12.5	¥	13.8	40.0	47.5	31.3	28.8	25.0	15.0	22.5	27.5	32.5	30.0	27 5	31 3
4	20.0	¥	17.5	¥	17.5	42.5	45.0	77.5	23.8	56.8	38.8	55.0	21.3	47.5	28.8	71 3	56 8
5	15.0	¥	15.0	¥	13.8	21.3	26.3	40.0	22.5	30.0	30.0	33.8	27.5	35.0	38.8	43 8	33 8
6	15.0	¥	12.5	¥	13.8	13.8	15.0	25.0	27.5	27.5	26.3	26.3	33.8	27.5	23.8	20 0	18 8
7	13.8	¥	12.5	¥	12.5	12.5	13.8	12.5	13.8	13.8	13.8	15.0	12.5	12.5	20.0	15 0	13 8
	17.0		15.2		15.4	42.1	38.9	42.7	28.0	37.9	23.4	40.2	22.6	40.7	34.6	46.8	39 8

¥ EMG data was not recorded during exercise   * data lost due to technical problems

Table 16 (cont.)

Subject 8

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	22.5	28.8	21.3	23.8	28.8	113.8	90.0	63.8	78.8	78.0	21.3	71.3	38.0	78.0	72.5	66.3	102.5
2	17.5	17.5	17.5	20.0	26.3	28.8	22.5	31.3	21.3	27.5	18.8	28.8	18.8	30.0	27.5	26.3	26.3
3	12.5	11.3	11.3	11.3	11.3	12.5	12.5	11.3	12.5	11.3	12.5	12.5	11.3	12.5	10.0	12.5	12.5
4	20.0	20.0	22.5	26.3	30.0	21.3	26.3	30.0	20.0	22.5	20.0	28.8	20.0	31.3	32.5	25.0	25.0
5	12.5	11.3	11.3	11.3	12.5	18.8	25.0	43.8	20.0	38.8	16.3	47.5	30.0	42.5	43.8	47.5	20.0
6	12.5	11.3	11.3	11.3	12.5	13.8	13.8	28.8	32.5	23.8	28.8	31.3	31.3	27.5	33.8	30.0	13.8
7	12.5	15.0	11.3	12.5	13.8	17.5	16.3	27.5	23.8	25.0	31.3	28.8	25.0	38.8	35.0	30.0	36.3
	15.7	16.4	15.2	16.6	19.3	32.3	29.5	36.6	29.8	32.0	21.3	35.5	24.5	36.8	36.4	33.9	33.8

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
3	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
4	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
5	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
6	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
7	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	47.5	66.3	65.0	32.5	48.8	78.8	91.3	71.3	68.8	68.8	70.0	63.8	21.3	77.5	88.0	62.5	36.3
2	18.8	20.0	17.5	20.0	20.0	20.0	21.3	27.5	22.5	22.5	18.3	23.8	20.0	27.5	23.8	22.5	21.3
3	13.8	16.3	20.0	12.5	17.5	13.8	26.3	15.0	25.0	16.3	12.5	15.0	12.5	13.8	13.8	13.8	12.5
4	16.3	17.5	15.0	22.5	21.3	15.0	16.3	22.5	27.5	20.0	13.8	20.0	18.8	20.0	18.8	18.8	27.5
5	12.5	12.5	11.3	12.5	13.8	18.8	23.8	28.8	27.5	25.0	20.0	25.0	16.3	28.8	31.3	25.0	16.3
6	10.0	12.5	10.0	11.3	18.8	16.3	13.8	20.0	21.3	17.5	17.5	17.5	18.8	20.0	18.8	17.5	15.0
7	11.3	12.5	10.0	11.3	12.5	13.8	17.5	16.3	17.5	18.8	12.5	17.5	21.3	16.3	17.5	15.0	16.3
	18.6	22.5	21.3	17.5	21.8	25.2	30.0	28.8	30.0	27.0	23.2	26.1	18.4	29.1	29.8	25.0	20.7

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	35.0	¥	63.8	¥	25.0	32.5	62.5	68.8	63.8	72.5	32.5	76.3	81.3	7.5	81.3	76.3	96.3
2	18.8	¥	32.5	¥	20.0	23.8	27.5	27.5	30.0	27.5	20.0	27.5	26.3	27.5	28.8	30.0	22.5
3	13.8	¥	21.3	¥	12.5	12.5	35.0	17.5	22.5	18.8	13.8	16.3	31.3	18.8	23.8	18.8	15.0
4	20.0	¥	21.3	¥	21.3	25.0	31.3	22.5	21.3	20.0	18.8	26.3	21.3	21.3	28.8	26.3	26.3
5	13.8	¥	13.8	¥	12.5	17.5	27.5	42.5	22.5	40.0	26.3	48.8	38.0	40.0	56.3	35.0	20.0
6	26.3	¥	15.0	¥	17.5	21.3	23.8	18.8	17.5	17.5	17.5	18.8	18.8	20.0	23.8	21.3	12.5
7	12.5	¥	12.5	¥	11.3	12.5	36.3	33.8	31.3	26.3	28.8	41.3	31.3	55.6	36.3	31.3	28.8
	20.9	¥	26.6	¥	17.1	20.7	37.7	33.0	31.3	31.6	22.5	36.4	35.0	23.9	39.8	34.1	31.6

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	48.8	¥	27.5	¥	56.3	56.3	76.3	81.3	67.5	63.8	42.5	53.8	42.5	70.0	72.5	57.5	60.0
2	18.8	¥	30.0	¥	17.5	26.3	27.5	32.5	17.5	25.0	22.5	22.5	18.8	31.3	27.5	26.3	23.8
3	18.8	¥	17.5	¥	17.5	15.0	32.5	37.5	21.3	27.5	30.0	18.3	28.8	23.8	25.0	17.5	20.0
4	17.5	¥	21.3	¥	16.3	21.3	17.5	63.8	18.8	20.0	18.8	18.8	21.3	29.8	48.8	18.8	21.3
5	15.0	¥	13.8	¥	12.5	25.0	16.3	32.5	22.5	30.0	18.8	25.0	21.3	31.3	35.0	31.3	16.3
6	12.5	¥	22.5	¥	12.5	13.8	12.5	12.5	12.5	12.5	13.8	12.5	15.0	12.5	12.5	12.5	13.8
7	13.8	¥	13.8	¥	12.5	13.8	18.8	40.0	31.3	37.5	53.8	48.3	47.5	41.3	42.5	50.0	13.8
	20.7	¥	20.9	¥	20.7	24.8	28.8	42.9	27.3	30.8	28.8	27.9	27.9	33.4	37.7	30.5	24.1

¥ EMG data was not recorded during exercise   * data lost due to technical problems

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Table 16 (cont.)

Subject 9

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	26.3	20.0	30.0	26.3	23.8	61.3	50.0	82.5	61.3	83.8	36.3	56.3	23.8	82.5	61.3	73.8	63.8
2	15.0	16.3	13.8	15.0	15.0	23.8	21.3	30.0	20.0	25.0	16.3	20.0	16.3	28.8	21.3	26.3	20.0
3	13.8	13.8	25.0	16.3	12.5	15.0	12.5	16.3	13.8	12.5	11.3	12.5	13.8	12.5	16.3	12.5	12.5
4	16.8	16.8	16.3	16.8	17.5	21.3	17.5	23.8	20.0	20.0	17.5	17.5	20.0	23.8	20.0	20.0	17.5
5	13.8	13.8	11.3	15.0	17.5	46.3	13.8	83.8	86.8	150.0	82.5	128.8	63.8	155.0	98.8	126.3	37.5
6	13.8	13.8	11.3	13.8	15.0	16.3	12.5	16.8	16.3	16.8	12.5	15.0	15.0	16.8	15.0	15.0	12.5
7	21.3	22.5	21.3	21.3	21.3	21.3	23.8	36.8	40.0	41.3	38.8	25.0	33.8	38.8	27.5	37.5	21.3
	17.5	17.0	18.4	18.0	17.5	29.3	21.6	42.0	37.1	50.2	30.7	39.3	26.6	51.4	37.1	44.5	26.4

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	46.3	22.5	66.3	47.5	52.5	73.8	86.3	102.5	80.0	125.0	37.5	76.3	31.3	86.3	101.3	115.0	67.5
2	21.3	13.8	20.0	20.0	16.3	32.5	32.5	35.0	18.8	36.3	18.8	20.0	16.3	30.0	26.3	32.5	22.5
3	23.8	11.3	22.5	12.5	20.0	23.8	13.8	38.8	17.5	26.3	12.5	20.0	15.0	13.8	15.0	40.0	12.5
4	17.5	15.0	16.3	16.3	13.8	16.8	23.8	26.8	16.3	30.0	16.3	23.8	17.5	21.3	20.0	38.8	22.5
5	22.5	12.5	15.0	22.5	11.3	26.3	26.3	76.3	33.8	83.8	53.8	60.0	30.0	80.0	66.3	72.5	17.5
6	18.8	11.3	12.5	11.3	10.0	16.3	12.5	18.8	13.8	18.8	13.8	16.3	16.3	16.3	15.0	17.5	13.8
7	25.0	10.0	11.3	10.0	10.0	12.5	13.8	23.8	16.3	17.5	17.5	16.3	31.3	25.0	20.0	25.0	41.3
	25.0	13.8	22.0	20.0	19.1	29.1	29.8	46.3	28.0	48.2	24.3	31.8	22.5	38.9	37.7	48.8	28.2

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	57.5	12.5	61.3	60.0	55.0	81.3	91.3	85.0	101.3	102.5	72.5	127.5	78.8	101.3	127.5	132.5	66.3
2	21.3	11.3	23.8	17.5	30.0	23.8	32.5	26.3	21.3	25.0	13.8	30.0	13.8	22.5	27.5	28.8	25.0
3	12.5	8.8	15.0	12.5	11.3	11.3	12.5	13.8	22.5	12.5	11.3	12.5	13.8	17.5	13.8	13.8	12.5
4	16.3	12.5	16.3	16.3	23.8	17.5	22.5	35.0	7.5	31.3	16.8	33.8	22.5	40.0	36.3	36.3	16.8
5	10.0	10.0	10.0	16.3	23.8	21.3	23.8	82.5	48.8	60.0	42.5	103.8	25.0	67.5	97.5	66.3	15.0
6	8.8	10.0	10.0	15.0	13.8	16.3	17.5	18.8	13.8	15.0	12.5	20.0	16.3	16.3	18.8	15.0	16.3
7	10.0	10.0	11.3	11.3	21.3	10.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.0
	19.5	10.7	19.6	19.8	25.5	25.9	30.4	37.3	30.7	35.2	24.5	46.8	24.3	37.9	46.3	41.8	26.4

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	16.8	♭	46.0	♭	30.0	45.0	55.0	55.0	52.5	76.3	40.0	75.0	42.5	78.8	112.5	75.0	75.0
2	16.8	♭	22.5	♭	21.3	25.0	35.0	35.0	40.0	46.3	35.0	35.0	33.8	46.3	38.8	26.3	56.3
3	11.3	♭	21.3	♭	15.0	12.5	16.8	16.8	12.5	15.0	15.0	20.0	12.5	13.8	26.3	15.0	15.0
4	30.0	♭	33.8	♭	22.5	20.0	30.0	30.0	26.8	33.8	26.3	32.5	23.8	32.5	27.5	22.5	28.8
5	13.8	♭	16.3	♭	27.5	31.3	81.3	70.0	62.5	86.3	78.8	100.0	65.0	111.3	100.0	102.5	37.5
6	11.3	♭	13.8	♭	13.8	12.5	16.8	16.8	15.0	15.0	17.5	18.8	13.8	17.5	17.5	17.5	13.8
7	16.3	♭	17.5	♭	15.0	13.8	22.5	22.5	26.8	23.8	22.5	26.3	16.8	25.0	26.3	16.8	17.5
	17.1		24.3		20.7	22.9	37.3	35.7	34.3	42.3	33.6	43.9	30.0	46.4	49.8	39.6	34.8

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	26.0	♭	27.5	♭	30.0	122.5	116.3	77.5	52.5	55.0	48.8	68.8	23.8	63.8	77.5	48.8	50.0
2	20.0	♭	20.0	♭	21.3	33.8	35.0	32.5	20.0	27.5	26.3	30.0	20.0	22.5	23.8	23.8	22.5
3	16.3	♭	15.0	♭	17.5	16.3	17.5	26.3	18.8	15.0	15.0	20.0	17.5	16.3	23.8	13.8	12.5
4	21.3	♭	21.3	♭	22.5	22.5	25.0	26.8	18.8	20.0	21.3	26.3	25.0	26.3	20.0	18.8	16.3
5	16.8	♭	16.3	♭	16.8	42.5	38.8	105.0	70.0	73.8	80.0	72.5	37.5	62.5	66.3	75.0	26.3
6	16.3	♭	17.5	♭	16.8	16.8	17.5	21.3	16.8	21.3	21.3	21.3	16.8	16.8	20.0	20.0	16.3
7	17.5	♭	16.8	♭	16.8	20.0	21.3	23.8	21.3	22.5	26.0	26.3	25.0	22.5	23.8	27.5	17.5
	19.3		19.5		21.1	39.5	38.8	45.0	31.4	33.6	33.9	37.9	23.9	33.2	35.8	32.5	23.0

♭ EMG data was not recorded during exercise * data lost due to technical problems

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Table 16 (cont.)

Subject 11

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	13.8	12.5	15.0	15.0	21.3	40.0	51.3	56.3	33.8	66.3	25.0	36.3	25.0	56.0	26.3	61.3	51.3
2	18.0	17.5	20.0	16.3	26.3	20.0	25.0	32.5	22.5	36.3	22.5	26.3	30.0	30.0	23.8	33.8	25.0
3	16.3	13.8	26.3	20.0	45.0	15.0	38.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	21.3	17.5	18.8	15.0	22.5	21.3	27.5	31.3	15.0	42.5	17.5	20.0	22.5	25.0	17.5	38.8	27.5
5	13.8	13.8	13.8	12.5	20.0	15.0	17.5	40.0	18.8	48.8	15.0	35.0	18.8	37.5	17.5	16.3	15.0
6	13.8	12.5	13.8	11.3	21.3	13.8	15.0	26.3	16.3	31.3	18.8	23.8	22.5	27.5	20.0	20.0	13.8
7	16.3	16.3	23.8	23.8	48.8	21.3	13.8	56.8	32.5	132.5	13.8	25.0	20.0	38.8	21.3	23.8	13.8
	15.7	14.8	18.8	16.3	29.3	20.9	27.0	35.0	19.8	51.1	16.1	23.8	19.8	30.5	18.0	27.7	20.9

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	47.5	60.0	48.8	56.3	56.3	78.8	85.0	80.0	48.8	45.0	21.3	72.5	18.8	73.8	31.3	27.5	70.0
2	16.3	16.3	16.3	16.3	17.5	33.8	30.0	36.3	25.0	20.0	26.3	38.8	16.3	38.8	27.5	26.8	27.5
3	40.0	35.0	35.0	35.0	42.5	47.5	71.3	37.5	43.8	20.0	26.3	55.0	15.0	55.0	47.5	42.5	78.8
4	16.3	16.3	17.5	16.3	17.5	18.8	17.5	40.0	16.3	16.3	16.3	38.8	16.3	37.5	17.5	16.3	16.3
5	12.5	12.5	12.5	12.5	12.5	17.5	16.3	53.8	21.3	37.5	36.3	47.5	26.3	50.0	25.0	18.8	13.8
6	11.3	11.3	12.5	11.3	12.5	13.8	12.5	32.5	22.5	22.5	20.0	37.5	25.0	35.0	17.5	16.3	11.3
7	15.0	23.8	17.5	12.5	12.5	16.3	15.0	38.8	36.3	26.3	20.0	29.8	23.8	30.0	26.3	22.5	13.8
	22.7	25.0	22.9	22.9	24.5	32.3	35.4	45.5	30.5	26.8	23.8	45.5	20.2	45.7	27.5	24.6	33.0

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	12.5	15.0	17.5	18.8	22.5	23.8	28.8	16.3	16.3	31.3	17.5	26.3	15.0	18.8	21.3	15.0	25.0
2	13.8	30.0	33.8	41.3	48.8	52.5	55.0	50.0	40.0	88.8	23.8	80.0	30.0	62.5	62.5	61.3	61.3
3	21.3	12.5	46.3	43.8	77.5	42.5	52.5	11.3	25.0	23.8	13.8	21.3	17.5	13.8	18.8	12.5	55.0
4	15.0	17.5	18.8	18.8	20.0	20.0	20.0	18.8	15.0	40.0	20.0	36.3	17.5	21.3	26.3	18.8	20.0
5	11.3	13.8	13.8	15.0	17.5	16.3	17.5	40.0	12.5	72.5	15.0	61.3	18.3	48.8	41.3	40.0	16.3
6	11.3	1.3	13.8	15.0	15.0	15.0	17.5	31.3	16.3	50.0	18.8	46.3	15.0	32.5	33.8	37.5	15.0
7	11.3	13.8	13.8	13.8	18.8	30.0	28.8	36.3	18.8	68.8	17.5	48.8	20.0	43.8	28.8	61.3	13.8
	13.8	14.8	22.5	23.8	31.4	28.8	31.4	29.1	20.5	53.6	18.0	45.7	18.5	34.5	31.8	35.2	29.5

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	31.3	¥	16.3	¥	18.8	43.8	26.3	32.5	23.8	41.3	25.0	42.5	25.0	56.3	20.0	31.3	47.5
2	21.3	¥	17.5	¥	17.5	22.5	23.8	22.5	15.0	26.3	21.3	26.3	20.0	42.5	17.5	23.8	26.3
3	20.0	¥	13.8	¥	12.5	15.0	36.8	17.5	23.8	15.0	13.8	17.5	15.0	33.8	12.5	20.0	17.5
4	18.8	¥	21.3	¥	18.8	23.8	33.8	23.8	15.0	31.3	20.0	26.3	21.3	35.0	18.8	23.8	27.5
5	15.0	¥	15.0	¥	12.5	26.3	15.0	42.5	11.3	50.0	23.8	50.0	18.8	51.3	30.0	40.0	21.3
6	12.5	¥	15.0	¥	13.8	20.0	15.0	23.8	13.8	26.8	20.0	31.3	17.5	51.3	15.0	32.5	16.3
7	21.3	¥	16.3	¥	18.8	30.0	21.3	48.8	36.3	87.5	37.5	58.8	36.3	73.8	33.8	60.0	36.3
	20.0		16.4		16.1	25.8	24.8	30.2	19.8	40.0	23.0	36.1	22.0	49.1	21.1	33.0	27.5

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	33.8	¥	11.3	¥	11.3	32.5	43.8	26.8	45.0	42.5	16.3	55.0	20.0	50.0	25.0	45.0	38.8
2	15.8	¥	13.8	¥	15.0	17.5	18.8	16.8	15.0	18.8	15.0	27.5	16.3	23.8	16.3	18.8	15.0
3	22.5	¥	10.0	¥	11.3	13.8	13.8	12.5	16.3	12.5	10.0	17.5	12.5	18.8	12.5	11.3	11.3
4	15.0	¥	17.5	¥	17.5	18.8	18.8	16.3	15.0	17.5	13.8	23.8	16.3	20.0	15.0	17.5	15.0
5	11.3	¥	11.3	¥	12.5	13.8	13.8	30.0	18.8	36.3	38.8	35.0	15.0	26.3	22.5	27.5	12.5
6	10.0	¥	10.0	¥	11.3	12.5	12.5	17.5	15.0	18.8	17.5	20.0	15.0	16.3	16.3	17.5	11.3
7	12.5	¥	20.0	¥	21.3	13.8	25.0	25.0	22.5	27.5	25.0	27.5	22.5	23.8	22.5	25.0	26.8
	17.0		13.4		14.3	17.5	20.9	21.3	21.1	24.8	19.5	29.5	16.8	25.5	18.6	23.2	18.8

¥ EMG data was not recorded during exercise

Table 16 (cont.)

Subject 12

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	11.3	13.8	11.3	16.3	21.3	65.0	70.0	70.0	51.3	87.5	65.0	82.5	27.5	80.0	86.3	88.8	67.5
2	21.3	26.3	23.8	31.3	15.0	25.0	31.3	18.8	16.3	23.8	15.0	21.3	15.0	17.8	17.5	18.8	17.5
3	18.8	21.3	17.5	27.5	11.3	25.0	37.5	15.0	12.5	46.3	15.0	16.3	12.5	13.8	13.8	15.0	13.8
4	15.0	17.5	15.0	13.8	15.0	17.5	17.5	27.5	17.5	30.0	16.3	31.3	18.8	22.5	21.3	25.0	16.3
5	11.3	12.5	11.3	10.0	12.5	15.0	15.0	66.3	25.0	76.3	50.0	67.5	61.3	71.3	67.5	72.5	13.8
6	11.3	12.5	11.3	10.0	11.3	12.5	12.5	15.0	15.0	18.8	13.8	15.0	15.0	15.0	16.3	17.5	11.3
7	10.0	12.5	11.3	10.0	11.3	12.5	12.5	13.8	12.5	12.5	11.3	12.5	12.5	11.3	13.8	11.3	11.3
	14.1	16.6	14.5	17.0	13.9	24.6	28.0	32.3	21.4	42.1	26.6	38.2	21.8	33.0	33.8	35.5	21.6

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	8.8	36.3	8.8	10.0	10.0	72.5	90.0	81.3	67.5	91.3	66.3	106.3	26.3	75.0	91.3	85.0	92.5
2	13.8	13.8	15.0	16.3	23.8	13.8	17.5	17.5	13.8	16.3	15.0	21.3	16.3	18.8	15.0	17.5	22.5
3	8.8	10.0	12.5	13.8	18.8	11.3	17.5	11.3	13.8	17.5	8.8	18.8	10.0	17.5	11.3	12.5	31.3
4	11.3	13.8	13.8	16.3	15.0	12.5	18.8	16.3	12.5	18.8	13.8	22.5	13.8	15.0	15.0	18.8	13.8
5	8.8	10.0	8.8	10.0	8.8	65.0	61.3	55.0	52.5	63.8	37.5	65.0	45.0	63.8	41.3	53.8	11.3
6	15.0	12.5	12.5	13.8	11.3	12.5	15.0	15.0	13.8	17.5	11.3	17.5	15.0	13.8	13.8	17.5	11.3
7	8.8	10.0	8.8	10.0	8.8	12.5	12.5	16.3	13.8	12.5	12.5	15.0	13.8	12.5	13.8	13.8	11.3
	10.7	15.2	11.4	12.9	13.8	28.6	33.2	30.4	29.6	33.9	23.6	38.0	20.0	30.9	28.8	31.3	27.7

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	12.5	22.5	12.5	21.3	52.5	75.0	50.0	77.5	53.8	50.0	35.0	126.3	26.3	121.3	116.3	147.5	63.8
2	12.5	13.8	12.5	11.3	26.3	13.8	12.5	11.3	12.5	12.5	13.8	12.5	13.8	12.5	13.8	12.5	13.8
3	12.5	25.0	26.3	13.8	55.0	35.0	22.5	57.5	23.8	26.3	13.8	30.0	25.0	76.3	16.3	31.3	15.0
4	16.3	20.0	17.5	15.0	23.8	16.3	16.3	21.3	17.5	20.0	18.8	26.3	20.0	23.8	20.0	23.8	20.0
5	12.5	13.8	12.5	11.3	52.5	55.0	12.5	60.0	48.8	53.8	21.3	56.3	48.8	47.5	47.5	48.8	13.8
6	12.5	13.8	12.5	11.3	23.8	12.5	12.5	13.8	13.8	16.3	18.8	17.5	16.3	15.0	18.8	15.0	13.8
7	12.5	13.8	12.5	11.3	53.8	18.8	18.8	20.0	22.5	22.5	21.3	20.0	23.8	18.8	20.0	21.3	12.5
	13.6	17.5	15.2	13.6	41.1	32.3	20.7	37.3	27.5	28.8	20.4	41.3	24.8	45.0	36.1	42.9	24.6

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	10.0	¥	10.0	¥	12.5	16.3	17.5	55.0	68.8	73.8	46.3	43.8	33.8	57.5	43.8	23.8	26.8
2	15.0	¥	16.3	¥	17.5	13.8	13.8	38.8	30.0	36.3	28.8	31.3	25.0	31.3	31.3	30.0	28.8
3	13.8	¥	12.5	¥	8.8	8.8	8.8	56.3	30.0	71.3	10.0	37.5	18.8	12.5	15.0	10.0	11.3
4	12.5	¥	12.5	¥	12.5	12.5	12.5	30.0	21.3	38.8	26.3	20.0	22.5	27.5	27.5	16.3	17.5
5	8.8	¥	8.8	¥	8.8	8.8	8.8	120.0	101.3	111.3	101.3	127.5	98.8	118.8	87.5	102.5	11.3
6	8.8	¥	8.8	¥	8.8	8.8	8.8	25.0	23.8	26.3	25.0	25.0	45.0	25.0	37.5	43.8	10.0
7	10.0	¥	11.3	¥	12.5	10.0	10.0	13.8	11.3	16.3	11.3	12.5	12.5	12.5	16.3	18.8	15.0
	11.3		11.4		11.6	11.3	11.4	48.4	40.9	53.4	35.5	42.5	36.6	40.7	37.0	35.0	17.5

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	16.3	¥	11.3	¥	12.5	21.3	28.8	22.5	32.5	26.3	2.5	23.8	15.0	37.5	26.3	30.0	285.0
2	15.0	¥	15.0	¥	16.3	12.5	17.5	15.0	16.3	15.0	15.0	16.3	13.8	18.8	15.0	16.3	22.5
3	10.0	¥	10.0	¥	11.3	11.3	15.0	12.5	15.0	11.3	12.5	12.5	12.5	15.0	13.8	12.5	20.0
4	13.8	¥	13.8	¥	16.3	13.8	13.8	16.3	16.3	16.3	16.3	16.3	15.0	17.5	17.5	16.3	15.0
5	10.0	¥	10.0	¥	11.3	10.0	10.0	57.5	47.5	36.3	36.3	60.0	46.3	52.5	48.8	53.8	11.3
6	10.0	¥	10.0	¥	11.3	10.0	10.0	22.5	13.8	12.5	13.8	20.0	12.5	15.0	15.0	25.0	11.3
7	12.5	¥	11.3	¥	12.5	11.3	12.5	23.8	33.8	67.5	93.8	18.3	17.5	38.8	35.0	56.3	88.3
	12.5		11.6		13.0	12.9	15.4	24.3	25.0	26.4	27.1	22.1	18.8	27.9	24.5	30.0	64.5

¥ E . data was not recorded during exercise

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Table 16 (cont.)

Subject 13

cond 1	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	22.5	27.5	38.8	61.3	68.3	86.3	73.8	131.3	83.8	106.8	56.8	110.0	46.8	120.0	117.5	100.0	107.5
2	16.0	16.3	28.8	17.5	25.0	36.3	26.3	46.8	17.5	35.0	17.5	28.8	20.0	30.0	33.8	32.5	35.0
3	11.3	11.3	10.0	8.8	11.3	11.3	27.5	20.0	16.8	20.0	13.8	16.3	17.5	32.5	25.0	17.5	25.0
4	17.5	20.0	32.5	16.8	16.8	23.8	22.5	51.3	15.0	26.3	16.3	16.3	16.8	21.3	23.8	26.3	32.5
5	15.0	13.8	13.8	12.5	20.0	17.5	16.3	35.0	33.8	43.8	13.8	46.3	42.5	61.3	42.5	35.0	21.3
6	12.5	11.3	12.5	16.0	15.0	12.5	15.0	30.0	20.0	30.0	27.5	16.8	27.5	25.0	27.5	30.0	11.3
7	17.5	26.3	41.3	32.5	26.8	21.3	15.0	20.0	21.3	30.0	23.8	16.3	17.5	17.5	20.0	22.5	11.3
	15.9	871421	25.4	23.8	26.4	29.8	28.0	47.7	30.0	42.0	24.5	38.1	27.5	42.5	41.4	37.7	34.8

cond 2	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
7	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

cond 3	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	15.0	36.3	42.5	43.8	55.0	65.0	62.5	68.8	47.5	61.3	38.8	103.8	57.5	92.5	96.8	118.8	67.5
2	21.3	30.0	22.5	32.5	33.8	33.8	37.5	23.8	17.5	22.5	16.3	43.8	13.8	32.5	22.5	26.3	26.3
3	13.8	31.3	42.5	52.5	33.8	15.0	46.3	13.8	16.3	13.8	12.5	93.8	10.0	12.5	16.3	31.3	23.8
4	16.8	26.3	22.5	20.0	31.3	35.0	32.5	32.5	26.8	31.3	16.8	33.8	21.3	30.0	30.0	35.0	32.5
5	15.0	23.8	13.8	15.0	15.0	16.8	16.3	90.0	30.0	37.5	31.3	20.0	26.3	37.5	23.8	33.8	15.0
6	13.8	22.5	13.8	15.0	17.5	20.0	21.3	31.3	21.3	16.8	16.0	17.5	23.8	27.5	26.8	25.0	17.5
7	16.8	60.0	13.8	22.5	23.5	41.3	38.8	112.5	57.5	38.8	26.8	40.0	46.8	53.8	45.0	40.0	22.5
	16.6	32.9	24.5	28.8	30.0	32.7	36.4	53.2	31.3	32.0	23.0	50.4	28.8	40.9	37.9	44.3	29.3

cond 4	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	21.3	¥	27.5	¥	38.8	65.0	83.8	83.8	56.8	82.5	41.3	66.8	46.8	135.0	87.5	95.0	75.0
2	16.8	¥	22.5	¥	17.5	36.3	38.3	38.3	16.8	43.8	16.3	40.0	17.8	70.0	33.8	63.8	46.3
3	12.5	¥	12.5	¥	13.8	12.5	31.3	15.0	21.3	25.0	13.8	15.0	12.5	21.3	13.8	76.3	22.5
4	16.8	¥	17.5	¥	16.8	22.5	27.5	22.5	21.3	41.3	21.3	22.5	20.0	47.5	21.3	22.5	75.0
5	13.8	¥	13.8	¥	15.0	21.3	22.5	148.8	53.8	53.8	13.8	88.8	55.0	65.0	61.3	13.8	12.5
6	15.0	¥	13.8	¥	13.8	12.5	16.3	56.3	33.8	30.0	25.0	51.3	28.8	45.0	37.5	25.0	12.5
7	12.5	¥	12.5	¥	13.8	15.0	16.3	50.0	33.8	36.3	26.8	60.0	33.8	42.5	36.3	26.3	13.8
	18.1		17.1		18.8	26.4	33.4	58.9	34.5	44.6	22.9	49.5	30.9	60.9	41.6	46.1	36.8

cond 5	12	24	36	45	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	153.8	¥	88.8	¥	63.8	70.0	76.3	125.0	55.0	113.8	31.3	141.3	125.0	115.0	122.5	147.5	72.5
2	18.8	¥	17.5	¥	16.3	32.5	30.0	52.5	16.3	47.5	17.5	52.5	61.3	43.8	47.5	51.3	30.0
3	15.0	¥	12.5	¥	11.3	8.8	10.0	16.3	11.3	12.5	12.5	13.8	32.8	11.3	11.3	11.3	11.3
4	16.8	¥	16.8	¥	22.5	36.0	32.5	21.3	16.3	22.5	17.5	20.0	31.3	21.3	20.0	17.5	33.8
5	10.0	¥	13.8	¥	12.5	12.5	23.8	55.0	16.8	42.5	38.8	40.0	51.3	43.8	41.3	43.8	16.3
6	16.3	¥	15.0	¥	12.5	12.5	20.0	25.0	22.5	25.0	26.3	37.5	32.8	35.0	32.5	21.3	13.8
7	12.5	¥	17.5	¥	16.3	23.8	67.5	43.8	31.3	35.0	20.0	45.0	45.0	45.0	53.8	60.0	25.0
	35.0		26.5		25.0	27.9	40.0	48.4	24.5	42.7	23.4	50.0	54.1	46.0	47.0	50.4	28.9

¥ EMG data was not recorded during exercise   * data lost due to technical problems

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Table 16 (cont.)

Subject 14

cond 1	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	56.3	55.0	45.0	105.0	41.3	60.0	56.3	65.0	63.8	88.8	37.5	62.5	61.3	65.0	63.8	97.5	40.0
2	13.8	15.0	13.8	18.8	13.8	30.0	27.5	22.5	16.3	25.0	17.5	22.5	21.3	23.8	25.0	35.0	28.8
3	18.8	26.3	13.8	55.0	13.8	18.8	18.8	13.8	30.0	15.0	13.8	17.5	13.8	13.8	15.0	16.3	17.5
4	18.8	21.3	18.8	21.3	18.8	37.5	53.8	20.0	20.0	22.5	1.3	23.8	18.8	18.8	23.8	21.3	75.0
5	15.0	13.8	15.0	21.3	13.8	27.5	20.0	27.5	17.5	30.0	31.3	32.5	25.0	28.8	30.0	32.5	15.0
6	13.8	15.0	13.8	17.5	13.8	20.0	20.0	27.5	38.8	23.8	35.0	40.0	33.8	28.8	31.3	36.3	17.5
7	12.5	15.0	15.0	16.3	12.5	16.3	13.8	25.0	25.0	28.8	22.5	27.5	21.3	27.5	25.0	27.5	12.5
	21.3	23.0	19.3	36.4	18.2	30.0	30.0	28.8	33.0	33.4	22.7	35.2	27.9	29.5	33.4	38.0	29.5

cond 2	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	41.3	43.8	40.0	58.8	57.5	60.0	76.0	112.5	118.8	91.3	70.0	95.0	70.0	92.5	100.0	21.3	62.5
2	13.8	13.8	15.0	17.5	16.3	32.5	31.3	25.0	16.3	27.5	18.8	23.8	18.8	28.8	26.3	41.3	27.5
3	13.8	11.3	13.8	13.8	15.0	13.8	13.8	13.8	12.5	13.8	13.8	11.3	11.3	12.5	13.8	13.8	13.8
4	20.0	20.0	20.0	20.0	20.0	46.3	31.3	30.0	18.8	38.8	22.5	28.8	25.0	35.0	27.5	26.3	22.5
5	13.8	12.5	13.8	17.5	16.3	21.3	25.0	36.3	15.0	43.8	28.8	37.5	30.0	36.3	32.5	21.3	20.0
6	13.8	15.0	13.8	13.8	15.0	17.5	20.0	18.8	15.0	20.0	16.3	16.3	13.8	17.5	18.8	22.5	15.0
7	13.8	12.5	21.3	16.3	20.0	13.8	25.0	37.5	26.3	41.3	26.3	37.5	32.5	32.5	38.8	36.3	15.0
	18.6	18.4	19.6	22.5	22.9	29.3	31.6	39.1	31.8	39.5	28.0	35.7	28.8	36.4	36.8	26.1	25.2

cond 3	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	90.0	33.8	43.8	45.0	50.0	60.0	53.8	115.0	118.8	121.3	96.3	96.3	62.5	88.8	95.0	151.3	80.0
2	11.3	10.0	12.5	12.5	15.0	38.3	28.8	16.3	13.8	37.5	27.5	25.0	12.5	22.5	22.5	23.8	27.5
3	31.3	8.8	10.0	11.3	10.0	22.5	21.3	23.8	47.5	18.8	13.8	15.0	11.3	16.3	16.3	21.3	20.0
4	13.8	13.8	17.5	18.3	15.0	60.0	28.8	23.8	15.0	26.3	17.5	26.3	15.0	22.5	22.5	28.8	27.5
5	10.0	10.0	11.3	11.3	11.3	17.5	26.3	60.0	60.0	81.3	75.0	82.5	27.5	66.3	66.3	63.8	28.8
6	10.0	10.0	11.3	12.5	12.5	18.8	26.3	36.3	32.5	40.0	37.5	38.8	35.0	35.0	35.0	40.0	16.3
7	8.8	8.8	10.0	10.0	8.8	8.8	11.3	15.0	13.8	13.8	12.5	15.0	15.0	16.3	16.3	13.8	11.3
	25.0	13.6	16.6	17.0	17.5	32.0	28.0	41.4	43.0	48.4	40.0	38.4	25.5	38.2	39.1	48.9	30.2

cond 4	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	46.3	�	38.8	�	36.3	47.5	55.0	80.0	70.0	58.8	47.5	61.3	42.5	73.8	78.8	67.5	37.5
2	12.5	�	11.3	�	11.3	15.0	15.0	22.5	16.3	17.5	17.5	20.0	13.8	20.0	18.8	15.0	25.0
3	12.5	�	11.3	�	11.3	23.8	27.5	51.3	63.8	15.0	18.8	15.0	12.5	32.5	30.0	13.8	41.3
4	20.0	�	18.8	�	22.5	22.5	32.5	25.0	16.3	23.8	23.8	23.8	16.3	21.3	40.0	21.3	46.3
5	13.8	�	12.5	�	12.5	13.8	15.0	41.3	43.8	42.5	55.0	50.0	26.3	40.0	45.0	32.5	15.0
6	12.5	�	11.3	�	11.3	13.8	13.8	20.0	20.0	21.3	17.5	20.0	20.0	20.0	23.8	21.3	22.5
7	12.5	�	11.3	�	11.3	11.3	11.3	31.3	23.8	26.3	23.8	42.5	23.8	26.3	42.5	27.5	12.5
	18.6		16.4		16.6	21.1	24.3	38.8	36.3	29.3	29.1	33.2	22.1	33.4	39.8	28.4	28.6

cond 5	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	30.0	�	20.0	�	27.5	52.5	55.0	66.3	81.3	63.8	60.0	81.3	60.0	71.3	66.3	43.8	65.0
2	11.3	�	11.3	�	11.3	30.0	28.8	18.8	17.5	23.8	18.8	33.8	15.0	26.3	22.5	15.0	32.5
3	10.0	�	10.0	�	10.0	13.8	15.0	13.8	42.5	18.8	16.3	20.0	17.5	20.0	16.3	13.8	20.0
4	13.8	�	13.8	�	13.8	42.5	48.8	17.5	16.3	21.3	17.5	22.5	16.3	23.8	17.5	16.3	45.0
5	11.3	�	10.0	�	10.0	13.8	15.0	41.3	43.8	40.0	43.8	41.3	42.5	40.0	37.5	38.8	15.0
6	10.0	�	10.0	�	10.0	13.8	16.3	22.5	22.5	27.5	23.8	27.5	18.8	32.5	23.8	18.8	13.8
7	10.0	�	10.0	�	10.0	11.3	13.8	27.5	22.5	35.0	27.5	27.5	22.5	35.0	30.0	27.5	11.3
	13.8		12.1		13.2	25.4	27.5	29.6	35.2	32.9	29.6	36.3	27.5	35.5	30.8	24.8	28.9

⋈ EMG data was not recorded during exercise   * data lost due to technical problems

Table 16 (cont.)

Subject 15

cond 1	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	16.3	13.8	12.5	16.8	22.5	21.3	26.8	43.8	22.5	68.8	36.3	46.8	36.3	60.0	62.5	67.5	22.5
2	13.8	13.8	13.8	13.8	16.3	20.0	20.0	22.5	13.8	22.5	15.0	17.5	16.3	22.5	20.0	21.3	22.5
3	13.8	17.5	12.5	12.5	13.8	13.8	13.8	31.3	11.3	13.8	13.8	15.0	12.5	13.8	13.8	13.8	16.3
4	16.8	17.5	16.8	17.5	21.3	26.8	31.3	20.0	15.0	33.8	16.8	20.0	17.5	26.8	21.3	26.8	25.0
5	13.8	12.5	12.5	12.5	13.8	15.0	16.3	20.0	13.8	22.5	17.5	17.5	16.3	16.8	16.8	17.5	13.8
6	13.8	12.5	12.5	12.5	12.5	13.8	20.0	16.8	12.5	16.8	15.0	17.5	15.0	15.0	15.0	15.0	15.0
7	12.5	12.5	12.5	12.5	15.0	13.8	16.3	16.3	12.5	31.3	17.5	20.0	31.3	22.5	26.3	30.0	12.5
	14.6	14.3	13.6	14.3	16.4	18.0	20.9	24.6	14.5	30.2	19.1	22.3	20.7	25.9	25.4	27.7	18.2

cond 2	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	10.0	10.0	10.0	27.5	35.0	47.5	148.8	105.0	76.3	93.8	13.8	113.8	30.0	73.8	82.5	135.0	47.5
2	10.0	11.3	11.3	16.8	16.8	40.0	23.8	43.8	25.0	31.3	16.3	41.3	16.8	33.8	26.3	37.5	16.8
3	10.0	10.0	10.0	13.8	12.5	30.0	22.5	26.8	26.3	25.0	13.8	32.5	21.3	23.8	22.5	16.8	25.0
4	16.8	25.0	16.8	16.8	30.0	41.3	16.8	32.5	20.0	21.3	16.3	25.0	16.8	21.3	20.0	27.5	36.3
5	10.0	10.0	10.0	12.5	13.8	15.0	13.8	60.0	46.3	52.5	31.3	73.8	36.8	45.0	52.5	56.8	20.0
6	8.8	10.0	10.0	13.8	13.8	12.5	12.5	26.3	26.8	30.0	27.5	36.8	16.3	25.0	31.3	35.0	16.3
7	8.8	10.0	8.8	10.0	10.0	12.5	12.5	36.8	36.3	41.3	21.3	63.8	43.8	27.5	40.0	26.8	16.3
	10.9	12.3	11.3	16.4	19.1	28.4	36.1	47.9	37.0	42.1	20.0	55.5	26.8	35.7	39.3	48.8	25.7

cond 3	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	12.5	15.0	27.5	26.3	53.8	37.5	40.0	91.3	65.0	58.8	85.0	88.8	91.3	91.3	113.8	90.0	16.8
2	16.3	15.0	16.3	21.3	23.8	31.3	27.5	32.5	17.5	32.5	27.5	33.8	16.3	32.5	21.3	32.5	32.5
3	12.5	13.8	15.0	15.0	12.3	25.0	15.0	25.0	21.3	22.5	31.3	16.3	20.0	23.8	23.8	25.0	16.3
4	20.0	20.0	20.0	26.8	16.8	52.5	33.8	26.8	16.8	31.3	27.5	26.8	16.8	21.3	16.8	23.8	55.0
5	12.5	12.5	12.5	12.5	11.3	15.0	16.3	56.3	15.0	63.8	57.5	56.3	21.3	53.8	31.3	62.5	15.0
6	12.5	12.5	12.5	15.0	15.0	23.8	21.3	23.8	12.5	27.5	26.3	22.5	20.0	22.5	16.3	25.0	15.0
7	11.3	11.3	11.3	12.5	11.3	11.3	12.5	60.0	55.0	30.0	36.0	42.5	55.0	31.3	17.5	35.0	12.5
	13.8	14.3	16.4	18.8	20.8	28.0	23.8	43.9	29.3	38.0	41.4	41.3	34.6	39.5	34.6	42.0	23.6

cond 4	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145
ch 1	16.8	⌷	16.0	⌷	13.8	27.5	36.8	68.8	103.8	93.8	62.5	108.8	71.3	112.5	115.0	101.3	31.3
2	16.8	⌷	21.3	⌷	17.5	75.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.3	108.8
3	16.8	⌷	17.5	⌷	13.8	12.5	13.8	20.0	11.3	13.8	12.5	13.8	13.8	20.0	16.3	16.3	13.8
4	22.5	⌷	16.8	⌷	20.0	46.3	51.3	42.5	17.5	36.3	16.8	45.0	22.5	42.5	25.0	47.5	45.0
5	13.8	⌷	13.8	⌷	13.8	46.3	56.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.3	26.3
6	15.0	⌷	12.5	⌷	13.8	15.0	16.3	25.0	13.8	37.5	26.3	33.8	27.5	35.0	25.0	25.0	15.0
7	16.8	⌷	20.0	⌷	13.8	16.3	20.0	65.0	42.5	70.0	26.3	65.0	41.3	66.3	38.8	57.5	16.8
	16.9		17.0		16.2	34.1	28.0	34.5	27.0	35.9	20.9	38.0	25.2	38.5	31.4	52.1	37.0

cond 5	12	24	36	48	60	100	125	c math	math	c relax	relax	c b hold	b hold	c water	water	c end	145 0
ch 1	16.3	⌷	12.5	⌷	21.3	46.3	65.0	121.3	106.3	100.0	67.5	110.0	107.5	111.3	92.5	97.5	37.5
2	13.8	⌷	11.3	⌷	11.3	16.3	15.0	22.5	23.8	17.5	20.0	35.0	23.8	22.5	17.5	17.5	33.8
3	13.8	⌷	12.5	⌷	12.5	36.3	25.0	17.5	16.3	17.5	15.0	23.8	21.3	23.8	17.5	17.5	32.5
4	26.8	⌷	26.3	⌷	22.5	17.5	41.3	40.0	22.5	21.3	16.8	26.8	30.0	52.5	32.5	33.8	22.5
5	25.0	⌷	11.3	⌷	12.5	16.8	15.0	25.0	15.0	30.0	20.0	26.3	21.3	33.8	30.0	31.3	15.0
6	12.5	⌷	17.5	⌷	11.3	15.0	23.8	26.8	15.0	25.0	27.5	26.3	21.3	27.5	25.0	23.8	22.5
7	12.5	⌷	11.3	⌷	11.3	26.3	13.8	46.3	37.5	43.8	20.0	43.8	26.8	45.0	42.5	38.8	12.5
	17.5		14.6		14.6	25.2	28.4	43.0	33.8	36.4	27.0	42.0	36.3	46.2	36.8	37.1	25.2

⌷ EMG data was not recorded during exercise   * data lost due to technical problems

Table 17.

Change in RMS (µV) using 4 Shiver Reduction Techniques (SRT)
(means of all subjects)

water	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus	chan 1-7
cond 1	10.38	4.42	0.31	2.40	8.56	-0.38	3.47	4.17
cond 2	7.05	12.95	3.41	5.23	9.20	4.20	1.25	6.19
cond 3	1.06	9.33	5.10	3.17	4.52	0.77	4.22	4.02
cond 4	13.75	11.35	3.75	6.63	3.13	3.46	6.25	6.90
cond 5	9.17	1.54	2.02	5.19	3.17	1.44	-0.25	3.18

relax	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus	chan 1-7
cond 1	44.38	14.04	7.81	12.31	25.19	5.29	18.47	18.21
cond 2	45.91	13.52	11.48	8.75	16.93	6.70	9.64	16.13
cond 3	26.63	16.15	4.71	7.98	14.62	4.13	6.88	11.59
cond 4	30.38	12.71	7.98	11.73	18.54	4.90	11.81	14.01
cond 5	37.08	10.96	2.98	3.56	4.33	2.12	0.83	8.84

breath hold	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus	chan 1-7
cond 1	22.60	6.54	5.73	5.29	14.62	1.06	-0.29	7.93
cond 2	49.20	16.14	9.09	6.36	18.30	6.02	2.73	15.41
cond 3	29.81	20.19	9.71	10.10	19.81	5.10	-0.83	13.41
cond 4	21.73	9.17	4.42	9.52	19.90	3.08	7.98	10.83
cond 5	27.40	12.88	2.40	6.63	7.40	3.37	2.29	8.91

math	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus	chan 1-7
cond 1	14.13	11.15	-0.29	10.19	19.62	3.46	0.10	8.34
cond 2	18.56	13.37	-0.48	7.98	14.71	2.79	-0.67	8.04
cond 3	15.00	11.35	-1.92	7.31	17.98	6.83	0.67	8.17
cond 4	8.08	10.96	-2.02	9.90	22.31	6.92	1.83	8.28
cond 5	10.19	10.67	1.06	12.02	15.48	3.37	-0.38	7.49

Table 18.

p-values from t-tests when comparing pre and post
Shiver Reduction Technique EMG activity .

(means of all subjects)

water	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus
cond 1	0.4293	0.1071	0.9222	0.1854	0.4840	0.8792	0.6035
cond 2	0.6393	0.0680	0.6425	0.3658	0.1207	0.5815	0.9224
cond 3	0.9068	0.2316	0.3456	0.4040	0.6872	0.8753	0.6760
cond 4	0.6185	0.1279	0.3123	0.1520	0.7831	0.4259	0.5587
cond 5	0.4674	0.8474	0.4296	0.1918	0.5249	0.5759	0.9262

relax	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus
cond 1	0.0013	0.0005	0.0938	0.0013	0.0568	0.0608	0.2037
cond 2	0.0011	0.0053	0.0437	0.1012	0.0064	0.0951	0.2741
cond 3	0.0649	0.0177	0.0418	0.0067	0.0619	0.3493	0.4562
cond 4	0.0001	0.0088	0.1402	0.0051	0.0886	0.0959	0.2632
cond 5	0.0014	0.0480	0.2338	0.3172	0.4876	0.3268	0.9210

breath hold	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus
cond 1	0.0310	0.1022	0.2357	0.0080	0.1515	0.7334	0.9255
cond 2	0.0004	0.0031	0.0810	0.2262	0.0133	0.1178	0.6830
cond 3	0.0568	0.0051	0.1397	0.0006	0.0108	0.1535	0.8867
cond 4	0.0179	0.0747	0.2056	0.0197	0.0981	0.4848	0.2464
cond 5	0.0548	0.0320	0.4112	0.1537	0.2325	0.2078	0.6655

math	traps	pecs	biceps	triceps	r.fem	biceps fem.	soleus
cond 1	0.2743	0.0013	0.9241	0.0035	0.0408	0.2385	0.4801
cond 2	0.1028	0.0010	0.9212	0.0433	0.0058	0.3410	0.5581
cond 3	0.3211	0.0215	0.5527	0.0057	0.0220	0.0408	0.6069
cond 4	0.3496	0.0231	0.7146	0.0017	0.0857	0.0668	0.3842
cond 5	0.3505	0.0597	0.7669	0.0439	0.0550	0.0968	0.6225

Table 19

Mean Cardiovascular and Respiratory Parameters

Condition 1

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	V̇E	%Δ V̇E	RR	%Δ RR	V̇CO2	%Δ V̇CO2
0	72.31	0.00	122.15	0.00	69.85	0.00	11.80	0.00	13.63	0.00	0.48	0.00
9	72.85	3.08	122.92	0.73	70.00	0.21	12.08	3.58	14.77	9.11	0.43	0.42
21	70.69	-0.81	122.31	0.24	73.08	4.71	12.58	7.44	13.63	0.89	0.45	3.70
33	74.23	4.52	123.54	0.52	73.69	5.75	13.15	17. J	13.83	1.72	0.50	21.68
45	71.54	-0.55	124.15	1.79	73.85	5.75	14.74	29.05	13.08	-2.40	0.54	28.25
57	73.23	3.42	123.38	1.17	72.46	3.80	16.94	51.77	12.71	-5.80	0.63	56.34
100	85.54	19.82					25.56	126.73	14.23	5.61	0.84	103.98
123	82.23	14.43					22.64	102.85	14.00	2.96	0.88	112.47
152	78.23	10.07					23.44	110.83	13.46	1.25	0.85	104.47

Condition 2

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	V̇E	%Δ V̇E	RR	%Δ RR	V̇CO2	%Δ V̇CO2
0	72.92	0.00	122.31	0.00	71.23	0.00	10.01	0.00	13.00	0.00	0.39	0.00
9	72.00	-1.55	121.08	-0.46	72.62	2.30	11.40	16.65	13.08	-1.53	0.43	9.47
21	72.31	0.01	122.32	0.92	73.23	2.29	11.36	15.91	13.23	2.09	0.45	25.20
33	71.92	-0.76	122.15	0.63	74.00	3.74	12.20	23.23	13.00	0.04	0.45	27.11
45	72.62	-0.26	122.31	0.64	72.15	1.62	14.33	48.04	13.38	3.60	0.53	48.64
57	74.54	2.36	124.31	2.31	73.85	3.01	16.34	68.32	13.62	6.57	0.62	62.78
100	84.69	17.26					26.12	167.64	15.23	20.79	0.98	151.83
123	82.92	14.75					24.46	155.30	15.77	26.62	0.91	118.55
152	79.54	8.61					23.05	141.57	14.46	13.96	0.84	113.54

Table 19 (cont)

Mean Cardiovascular and Respiratory Parameters

Condition 3

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	74.77	0.00	119.38	0.00	71.83	0.00	11.55	0.00	13.50	0.00	0.46	0.00
9	77.46	3.38	119.85	0.08	72.67	0.25	12.85	16.97	13.50	-1.25	0.46	6.67
21	71.69	-3.24	121.23	1.61	73.33	0.95	12.20	8.76	13.25	2.02	0.44	4.12
33	73.15	-1.45	121.38	1.53	74.83	3.54	11.85	8.51	13.25	2.35	0.44	11.77
45	72.23	-2.60	120.00	0.56	74.00	2.18	13.91	28.73	13.58	3.48	0.52	39.37
57	75.92	3.77	119.54	-0.38	72.83	0.05	18.10	63.15	15.00	13.44	0.69	63.46
100	81.92	12.09					24.59	128.38	16.67	28.12	0.93	135.58
123	87.54	20.39					23.71	115.03	14.25	6.07	0.88	120.66
152	83.69	13.85					23.78	120.45	13.83	4.90	0.85	112.11

Condition 4

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	72.08	0.00	124.00	0.00	69.08	0.00	12.36	0.00	14.23	0.00	0.46	0.00
9	79.08	10.96	125.54	1.03	69.69	-0.24	13.19	3.55	15.00	4.64	0.47	14.15
21	152.62	105.86	176.46	37.97	67.38	-2.90	61.66	422.84	26.00	87.78	2.75	397.45
33	90.77	25.28	125.85	1.44	67.69	-2.89	13.70	11.78	15.15	7.65	0.47	22.42
45	152.15	104.38	177.08	38.80	66.31	-3.22	59.56	408.09	25.23	82.19	2.73	412.23
57	93.00	28.81	125.08	1.20	68.46	-2.12	13.90	16.05	15.62	12.28	0.48	38.45
100	88.31	24.43					22.32	88.62	14.38	3.71	0.83	109.81
123	87.46	26.35					25.94	116.20	14.27	2.03	0.95	123.68
152	85.92	21.14					25.26	111.47	15.35	10.08	0.88	123.98

Table 19 (con')

Mean Cardiovascular and Respiratory Parameters

Condition 5

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	69.85	0.0	121.54	0.00	70.08	0.00	11.22	0.00	14.58	0.00	0.41	0.00
9	72.15	4.4	120.46	-0.52	73.23	4.13	12.32	8.23	12.23	-15.16	0.44	14.43
21	151.92	116.3	167.08	34.29	64.15	-7.08	67.49	529.24	27.23	95.11	2.96	462.88
33	93.15	36.5	125.23	3.78	72.15	2.47	13.06	18.97	16.31	17.24	0.44	25.97
45	148.92	111.7	174.38	40.91	65.23	-5.07	58.68	431.89	27.23	93.35	2.57	397.99
57	93.15	35.2	124.92	3.40	69.54	0.81	14.35	27.99	15.62	10.07	0.45	43.59
100	90.54	32.0					24.34	118.21	16.15	14.69	0.90	146.96
123	89.38	31.9					26.43	140.17	15.85	11.66	0.94	143.59
152	85.92	24.5					23.99	117.49	15.46	10.60	0.88	125.81

· %= ((t-to)/to)x100

Units
HR = beats/min
Blood Pressure (mmHg)
VE = liters/min
VCO2 = Carbon Dioxide Production (liters/min)
RR = Respiratory Rate (breaths/min)

Table 20. Cardiovascular and Respiratory Parameters
Condition 1

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
1	0	80.00	0.00	130.00	0.00	68.00	0.00	9.76	0.00	14.00	0.00	0.40	0.00
	9	68.00	-15.00	132.00	1.54	70.00	2.94	10.46	7.20	14.00	0.00	0.41	3.80
	21	68.00	-15.00	130.00	0.00	70.00	2.94	11.16	14.29	13.00	-7.14	0.48	22.15
	33	63.00	-21.25	130.00	0.00	78.00	14.71	13.05	33.71	15.00	7.14	0.57	43.04
	45	67.00	-16.25	130.00	0.00	80.00	17.65	12.48	27.87	13.00	-7.14	0.53	34.81
	57	68.00	-15.00	126.00	-3.08	76.00	11.76	12.28	25.82	13.00	-7.14	0.47	17.72
	100	84.00	5.00							15.00	7.14		
	123	79.00	-1.25					15.15	55.17	17.00	21.43	0.67	69.62
	152	73.00	-8.75					17.47	79.02	17.00	21.43	0.77	94.30
2	0	80.00	0.00	120.00	0.00	72.00	0.00	18.06	0.00	14.00	0.00	0.57	0.00
	9	75.00	-6.25	130.00	8.33	72.00	0.00	14.27	-21.00	9.00	-35.71	0.48	-15.35
	21	73.00	-8.75	130.00	8.33	72.00	0.00	16.49	-8.69	9.00	-35.71	0.56	-2.63
	33	78.00	-2.50	130.00	8.33	74.00	2.78	12.81	-29.09	10.00	-28.57	0.47	-18.42
	45	82.00	2.50	128.00	6.67	74.00	2.78	20.49	13.44	10.00	-28.57	0.70	21.93
	57	80.00	0.00	130.00	8.33	74.00	2.78	23.00	27.34	11.00	-21.43	0.85	48.68
	100	92.00	15.00					32.50	79.95	12.00	-14.29	0.31	-46.05
	123	85.00	6.25					27.35	51.45	10.00	-28.57	1.12	96.93
	152	91.00	13.75					27.98	54.95	8.00	-42.86	1.06	86.40
4	0	92.00	0.00	130.00	0.00	70.00	0.00	20.08	0.00	10.25	0.00	1.28	0.00
	9	80.00	-13.04	118.00	-9.23	68.00	-2.86	16.12	-19.72	12.00	17.07	0.51	-60.43
	21	78.00	-15.22	122.00	-6.15	70.00	0.00	19.69	-1.92	13.25	29.27	0.65	-49.12
	33	74.00	-19.57	124.00	-4.62	68.00	-2.86	15.86	-21.02	15.75	53.66	0.52	-59.84
	45	84.00	-8.70	118.00	-9.23	70.00	0.00	16.50	-17.82	12.00	17.07	0.55	-57.50
	57	78.00	-15.22	118.00	-9.23	66.00	-5.71	15.85	-21.07	14.25	39.02	0.52	-59.65
	100	97.00	5.43					30.89	53.84	13.00	26.83	1.14	-11.31
	123	83.00	-9.78					26.24	30.71	11.00	7.32	1.16	-9.36
	152	82.00	-10.87					22.75	13.32	15.00	46.34	0.93	-27.29

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 1

Subj 5 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	64.00	0.00	124.00	0.00	70.00	0.00	7.08	0.00	11.00	0.00	0.36	0.00
9	73.00	14.06	120.00	-3.23	68.00	-2.86	3.90	-44.92	8.00	-27.27	0.20	-45.52
21	65.00	1.56	120.00	-3.23	74.00	5.71	4.98	-29.70	7.00	-36.36	0.28	-23.45
33	80.00	25.00	120.00	-3.23	76.00	8.57	5.71	-19.39	9.00	-18.18	0.32	-11.03
45	65.00	1.56	132.00	6.45	78.00	11.43	8.53	20.48	12.00	9.09	0.41	13.10
57	68.00	6.25	124.00	0.00	76.00	8.57	7.82	10.49	8.00	-27.27	0.43	17.93
100	78.00	21.88					14.08	98.87	14.00	27.27	0.62	70.34
123	83.00	29.69					9.84	38.95	7.00	-36.36	0.50	38.62
152	85.00	32.81					11.25	58.90	10.00	-9.09	0.53	46.90

Subj 6 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	40.00	0.00	114.00	0.00	70.00	0.00	9.70	0.00	16.00	0.00	0.29	0.00
9	58.00	45.00	112.00	-1.75	68.00	-2.86	17.39	79.30	20.00	25.00	0.53	81.90
21	47.00	17.50	120.00	5.26	82.00	17.14	18.49	90.59	11.00	-31.25	0.64	121.55
33	56.00	40.00	122.00	7.02	80.00	14.29	18.15	87.11	14.00	-12.50	0.68	132.76
45	43.00	7.50	120.00	5.26	70.00	0.00	24.79	155.54	16.00	0.00	0.82	181.90
57	53.00	32.50	122.00	7.02	74.00	5.71	26.85	176.83	15.00	-6.25	0.96	231.03
100	68.00	70.00					48.20	396.91	19.00	18.75	1.13	287.93
123	42.00	5.00					38.79	299.92	19.00	18.75	0.93	219.83
152	53.00	32.50					35.90	270.13	12.00	-25.00	0.88	201.72

Subj 7 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	88.00	0.00	118.00	0.00	70.00	0.00	12.40	0.00	12.00	0.00	0.55	0.00
9	80.00	-9.09	120.00	1.69	70.00	0.00	13.62	9.84	17.00	41.67	0.57	2.73
21	82.00	-6.82	118.00	0.00	74.00	5.71	13.61	9.70	15.00	25.00	0.60	8.18
33	80.00	-9.09	116.00	-1.69	74.00	5.71	17.61	41.95	13.00	8.33	0.75	36.36
45	81.00	-7.95	116.00	-1.69	74.00	5.71	22.06	77.85	11.00	-8.33	0.93	69.55
57	78.00	-11.36	120.00	1.69	80.00	14.29	21.16	70.57	7.00	-41.67	0.94	70.91
100	114.00	29.55					34.17	175.47	9.00	-25.00	1.42	157.73
123	93.00	5.68					28.48	129.65	14.00	16.67	1.12	103.64
152	72.00	-18.18					27.04	118.02	10.00	-16.67	1.02	85.91

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 1

Subj 8	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	68.00	0.00	120.00	0.00	68.00	0.00	12.67	0.00	15.00	0.00	0.45	0.00
	9	76.00	11.76	128.00	6.67	66.00	-2.94	12.73	0.45	19.00	26.67	0.43	-4.97
	21	82.00	20.59	124.00	3.33	70.00	2.94	12.98	2.49	22.00	46.67	0.46	1.66
	33	76.00	11.76	132.00	10.00	70.00	2.94			19.00	26.67		
	45	72.00	5.88	130.00	8.33	74.00	8.82	14.80	16.85	18.00	20.00	0.49	8.29
	57	74.00	8.82	136.00	13.33	72.00	5.88	16.56	30.73	16.00	6.67	0.58	28.73
	100	62.00	-8.82					23.23	83.40	18.00	20.00	0.90	99.45
	123	72.00	5.88					19.29	52.28	18.00	20.00	0.77	69.61
	152	72.00	5.88					23.95	89.05	17.00	13.33	0.91	101.66

Subj 9	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	80.00	0.00	122.00	0.00	68.00	0.00	9.82	0.00	12.00	0.00	0.38	0.00
	9	79.00	-1.25	128.00	4.92	68.00	0.00	10.13	3.18	14.00	16.67	0.33	-11.33
	21	77.00	-3.75	122.00	0.00	72.00	5.88	13.47	37.19	17.00	41.67	0.44	18.00
	33	85.00	6.25	120.00	-1.64	70.00	2.94	13.21	34.54	16.00	33.33	0.45	19.33
	45	89.00	11.25	120.00	-1.64	72.00	5.88	13.67	39.30	14.00	16.67	0.48	28.00
	57	84.00	5.00	120.00	-1.64	68.00	0.00	16.94	72.57	18.00	50.00	0.65	73.33
	100	83.00	3.75					30.51	210.88	22.00	83.33	1.12	197.33
	123	88.00	10.00					24.48	149.39	20.00	66.67	0.81	116.00
	152	98.00	22.50					30.44	210.14	20.00	66.67	0.97	159.33

Subj 11	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	80.00	0.00	128.00	0.00	70.00	0.00	10.72	0.00	19.00	0.00	0.31	0.00
	9	82.00	2.50	124.00	-3.13	74.00	5.71	12.89	20.25	20.00	5.26	0.47	50.40
	21	82.00	2.50	120.00	-6.25	74.00	5.71	10.90	1.68	18.00	-5.26	0.39	24.00
	33	90.00	12.50	122.00	-4.69	74.00	5.71	14.15	31.98	13.00	-31.58	0.54	73.60
	45	78.00	-2.50	122.00	-4.69	70.00	0.00	9.98	-6.88	13.00	-31.58	0.39	23.20
	57	84.00	5.00	124.00	-3.13	72.00	2.86	13.78	28.55	12.00	-36.84	0.59	87.20
	100	126.00	57.50					17.50	63.26	16.00	-15.79	0.77	146.40
	123	112.00	40.00					20.20	88.48	14.00	-26.32	0.82	161.60
	152	86.00	7.50					18.85	75.88	12.00	-36.84	0.73	134.40

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 1

Subj 12 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	68.00	0.00	130.30	0.00	82.00	0.00	12.21	0.00	13.00	0.00	0.55	0.00
9	70.00	2.94	126.00	-3.08	84.00	2.44	12.59	3.11	15.00	15.38	0.46	-15.91
21	65.00	-4.41	128.00	-1.54	80.00	-2.44	10.05	-17.70	16.00	23.08	0.37	-32.27
33	73.00	7.35	130.00	0.00	84.00	2.44	14.79	21.18	16.00	23.08	0.54	-1.36
45	66.00	-2.94	130.00	0.00	86.00	4.88	12.91	5.78	16.00	23.08	0.52	-5.00
57	76.00	11.76	128.00	-1.54	80.00	-2.44	17.46	43.06	14.00	7.69	0.63	13.64
100	78.00	11.76					18.54	51.90	11.00	-15.38	0.80	44.55
123	90.00	32.35					21.59	78.92	14.00	7.69	0.87	57.73
152	76.00	11.76					24.42	100.06	12.00	-7.69	0.91	65.91

Subj 13 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	68.00	0.00	118.00	0.00	68.00	0.00	10.59	0.00	15.00	0.00	0.43	0.00
9	76.00	11.76	122.00	3.39	66.00	-2.94	9.41	-11.15	14.00	-6.67	0.37	-12.94
21	74.00	8.82	122.00	3.39	68.00	0.00	9.48	-10.44	12.00	-20.00	0.42	-1.18
33	78.00	14.71	122.00	3.39	68.00	-2.94	8.97	-15.30	11.00	-26.67	0.42	-2.35
45	72.00	5.88	124.00	5.08	68.00	0.00	9.73	-8.10	13.00	-13.33	0.43	0.00
57	72.00	5.88	124.00	5.08	66.00	-2.94	10.24	-3.28	13.00	-13.33	0.51	20.59
100	68.00	0.00					15.55	46.91	11.00	-26.67	0.75	76.47
123	94.00	38.24					13.70	29.40	11.00	-26.67	0.62	45.29
152	68.00	0.00					15.02	41.92	9.00	-40.00	0.74	74.71

Subj 14 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	60.00	0.00	114.00	0.00	64.00	0.00	12.05	0.00	11.00	0.00	0.43	0.00
9	58.00	-3.33	116.00	1.75	66.00	3.13	11.17	-7.28	18.00	63.64	0.41	-4.68
21	63.00	5.00	112.00	-1.75	64.00	0.00	16.20	34.44	11.00	0.00	0.60	39.77
33	63.00	5.00	116.00	1.75	64.00	0.00	12.68	5.21	10.00	-9.09	0.51	18.13
45	53.00	-11.67	122.00	7.02	64.00	0.00	14.85	23.20	9.00	-18.18	0.58	34.50
57	74.00	23.33	114.00	0.00	62.00	-3.13	13.79	14.42	9.00	-18.18	0.55	28.65
100	68.00	13.33					27.15	125.31	11.00	0.00	1.16	171.35
123	72.00	20.00					16.29	35.21	6.00	-45.45	0.76	77.19
152	66.00	10.00					18.87	56.56	11.00	0.00	0.90	110.53

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 1

Subj 15	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	72.00	0.00	120.00	0.00	68.00	0.00	8.25	0.00	15.00	0.00	0.24	0.00
	9	72.00	0.00	122.00	1.67	70.00	2.94	10.80	30.90	14.00	-6.67	0.31	29.79
	21	63.00	-12.50	122.00	1.67	80.00	17.65	6.76	-18.06	16.00	6.67	0.16	-30.85
	33	69.00	-4.17	122.00	1.67	80.00	17.65	12.67	53.56	17.00	13.33	0.36	52.13
	45	78.00	8.33	122.00	1.67	30.00	17.65	10.26	24.36	11.00	-26.67	0.27	14.89
	57	63.00	-12.50	118.00	-1.67	76.00	11.76	24.35	195.03	19.00	26.67	0.66	181.91
	100	96.00	33.33					27.66	235.11	18.00	20.00	0.86	263.83
	123	76.00	5.56					32.98	299.61	19.00	26.67	1.02	334.04
	152	95.00	31.94					30.78	272.95	22.00	46.67	0.86	267.02

Table 20 (cont.)   Cardiovascular and Respiratory Parameters

Condition 2

Subj	Time (min)	HR	%∆ HR	Systolic	%∆ Systolic	Diastolic	%∆ Diastolic	VE	%∆ VE	VO2	%∆ VO2	VCO2	%∆ VCO2
1	0	84.00	0.00	134.00	0.00	72.00	0.00	9.64	0.00	0.47	0.00	0.46	0.00
	9	79.00	-5.95	130.00	-2.99	80.00	11.11	8.67	-10.04	0.40	-14.52	0.48	2.70
	21	79.00	-5.95	132.00	-1.49	82.00	13.89	15.29	58.63	0.60	27.96	0.82	76.76
	33	75.00	-10.71	132.00	-1.49	84.00	16.67	8.27	-14.22	0.33	-30.11	0.46	-1.62
	45	78.00	-7.14	134.00	0.00	84.00	16.67	9.61	-0.34	0.36	-22.04	0.53	14.59
	57	75.00	-10.71	132.00	-1.49	84.00	16.67	16.14	67.44	0.74	58.60	0.79	71.35
	100	90.00	7.14					17.09	77.28	0.71	52.15	0.83	78.38
	123	79.00	-5.95					13.83	43.50	0.65	38.71	0.69	48.11
	152	95.00	13.10					16.75	73.75	0.71	52.15	0.80	73.51
2	0	68.00	0.00	118.00	0.00	64.00	0.00	9.89	0.00	0.51	0.00	0.46	0.00
	9	82.00	20.59	114.00	-3.39	64.00	0.00	9.60	-2.93	0.35	-32.68	0.35	-23.08
	21	85.00	25.00	114.00	-3.39	62.00	-3.13	10.37	4.83	0.37	-28.29	0.39	-13.74
	33	73.00	7.35	116.00	-1.69	64.00	0.00	15.30	54.66	0.51	0.00	0.57	24.18
	45	73.00	7.35	116.00	-1.69	60.00	-6.25	16.06	62.37	0.52	0.98	0.63	37.91
	57	83.00	22.06	122.00	3.39	62.00	-3.13	12.96	31.03	0.40	-21.46	0.48	4.95
	100	94.00	38.24					25.90	161.79	0.93	81.95	0.98	115.93
	123	92.00	35.29					22.10	123.35	0.78	51.22	0.84	85.16
	152	94.00	38.24					24.16	144.25	0.70	35.61	0.86	88.46
4	0	84.00	0.00	114.00	0.00	74.00	0.00	12.80	0.00	0.49	0.00	0.41	0.00
	9	84.00	0.00	110.00	-3.51	74.00	0.00	10.93	-14.60	0.38	-23.35	0.37	-9.70
	21	84.00	0.00	112.00	-1.75	78.00	5.41	11.25	-12.11	0.40	-18.27	0.41	-1.82
	33	90.00	7.14	110.00	-3.51	72.00	-2.70	12.99	1.50	0.50	1.52	0.55	32.73
	45	73.00	-13.10	118.00	3.51	78.00	5.41	12.02	-6.08	0.45	-9.64	0.46	12.12
	57	94.00	11.90	118.00	3.51	78.00	5.41	10.97	-14.24	0.50	1.02	0.44	6.06
	100	94.00	11.90					22.71	77.49	0.81	64.97	1.06	156.97
	123	100.00	19.05					16.49	28.84	0.55	12.18	0.67	61.82
	152	85.00	1.19					12.60	-1.50	0.62	26.40	0.57	37.58

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 2

Subj 5 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
0	68.00	0.00	120.00	0.00	70.00	0.00	5.60	0.00	0.32	0.00	0.26	0.00
9	69.00	1.47	120.00	0.00	72.00	2.86	5.95	6.20	0.25	-22.66	0.24	-4.90
21	72.00	5.88	118.00	-1.67	72.00	2.86	4.53	-19.23	0.21	-34.38	0.19	-25.49
33	85.00	25.00	110.00	-8.33	70.00	0.00	5.38	-3.97	0.25	-21.88	0.24	-7.84
45	75.00	10.29	110.00	-8.33	68.00	-2.86	7.79	39.05	0.35	7.81	0.37	43.14
57	80.00	17.65	120.00	0.00	70.00	0.00	9.19	64.03	0.41	26.56	0.45	74.51
100	87.00	27.94					17.16	206.20	0.94	193.75	0.79	208.82
123	80.00	17.65					19.30	244.53	0.96	198.44	0.78	203.92
152	77.00	13.24					17.59	213.92	0.74	131.25	0.69	170.59

Subj 6 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
0	56.00	0.00	124.00	0.00	70.00	0.00	13.98	0.00	0.60	0.00	0.41	0.00
9	44.00	-21.43	118.00	-4.84	66.00	-5.71	18.41	31.72	0.56	-7.05	0.55	33.74
21	40.00	-28.57	128.00	3.23	66.00	-5.71	11.70	-16.28	0.40	-34.44	0.33	-19.02
33	44.00	-21.43	122.00	-1.61	70.00	0.00	18.89	35.15	0.57	-5.81	0.52	27.61
45	46.00	-17.86	124.00	0.00	66.00	-5.71	18.69	33.74	0.68	12.03	0.58	41.72
57	48.00	-14.29	128.00	3.23	64.00	-8.57	25.50	82.43	0.78	29.88	0.80	96.93
100	56.00	0.00					41.82	199.27	0.93	54.77	1.01	148.47
123	60.00	7.14					35.73	155.67	0.79	31.12	0.92	125.77
152	48.00	-14.29					34.80	149.03	0.96	58.51	0.91	123.93

Subj 7 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
0	84.00	0.00	116.00	0.00	62.00	0.00	7.42	0.00	0.45	0.00	0.36	0.00
9	81.00	-3.57	120.00	3.45	72.00	16.13	17.47	135.56	0.56	25.14	0.59	66.90
21	77.00	-8.33	120.00	3.45	72.00	16.13	12.31	65.99	0.49	9.50	0.49	38.73
33	80.00	-4.76	118.00	1.72	70.00	12.90	15.61	110.48	0.74	64.80	0.58	62.68
45	90.00	7.14	118.00	1.72	64.00	3.23	20.32	173.95	0.77	72.07	0.66	84.51
57	82.00	-2.38	120.00	3.45	64.00	3.23	24.51	230.43	0.93	107.26	0.88	148.59
100	90.00	7.14					33.45	350.99	1.23	173.74	1.17	230.28
123	82.00	-2.38					34.78	368.89	1.35	201.12	1.29	263.38
152	79.00	-5.95					31.55	325.38	1.16	159.22	1.08	204.93

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 2

Subj 8 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
0	76.00	0.00	122.00	0.00	76.00	0.00	11.64	0.00	.49	0.00	0.47	0.00
9	67.00	-11.84	120.00	-1.64	72.00	-5.26	12.34	6.01	0.48	-1.53	0.45	-5.82
21	67.00	-11.84	124.00	1.64	74.00	-2.63	10.57	-9.??	0.42	-14.29	0.39	-16.93
33	60.00	-21.05	130.00	6.56	80.00	5.26	9.91	-14.?6	0.42	-15.31	0.37	-21.69
45	65.00	-14.47	124.00	1.64	80.00	5.26	11.26	-3.3.	?.49	0.51	0.47	-0.53
57	70.00	-7.89	126.00	3.28	80.00	5.26	18.11	55.51	0.77	57.65	0.78	64.55
100	70.00	-7.89					28.10	141.38	1.25	154.59	1.17	146.56
123	85.00	11.84					23.87	105.00	1.13	130.10	1.09	129.63
152	69.00	-9.21					25.25	116.83	1.16	137.24	1.11	133.86

Subj 9 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
0	68.00	0.00	120.00	0.00	76.00	0.00	10.63	0.00	0.45	0.00	0.37	0.00
9	73.00	7.35	122.00	1.67	80.00	5.26	9.49	-10.75	0.42	-7.73	0.33	-10.81
21	64.00	-5.88	120.00	0.00	80.00	5.26	11.45	7.69	0.54	19.89	0.40	8.78
33	80.00	17.65	122.00	1.67	80.00	5.26	14.84	39.58	0.55	21.55	0.45	22.30
45	81.00	19.12	122.00	1.67	74.00	-2.63	14.78	38.99	0.64	40.33	0.53	43.92
57	64.00	-5.88	122.00	1.67	80.00	5.26	8.76	-17.62	0.40	-11.05	0.32	-14.19
100	84.00	23.53					21.64	103.55	0.90	97.79	0.76	106.08
123	75.00	10.29					16.69	57.03	0.87	92.82	0.64	72.97
152	82.00	20.59					14.44	35.87	0.67	48.62	0.49	32.43

Subj 11 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
0	82.00	0.00	128.00	0.00	82.00	0.00	8.81	0.00	0.37	0.00	0.29	0.00
9	78.00	-4.88	126.00	-1.56	80.00	-2.44	12.39	40.74	0.49	31.54	0.48	89.30
21	84.00	2.44	124.00	-3.13	80.00	-2.44	13.83	57.04	0.57	53.02	0.54	89.47
33	78.00	-4.88	130.00	1.56	80.00	-2.44	10.28	16.70	0.42	12.08	0.38	34.21
45	72.00	-12.20	128.00	0.00	80.00	-2.44	14.43	63.88	0.53	41.61	0.42	45.61
57	80.00	-2.44	132.00	3.13	80.00	-2.44	12.46	41.51	0.54	44.97	0.46	59.65
100	94.00	14.63					20.12	128.51	0.80	115.44	0.78	171.93
123	90.00	9.76					20.65	134.55	0.76	104.70	0.75	163.16
152	96.00	17.07					34.72	294.29	1.11	196.64	1.16	305.26

Table 20 (cont.)   Cardiovascular and Respiratory Parameters

Condition 2

Subj 12	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
	0	76.00	0.00	130.00	0.00	72.00	0.00	10.32	0.00	0.46	0.00	0.55	0.00
	9	81.00	6.58	118.00	-9.23	72.00	0.00	8.48	-17.83	0.36	-20.88	0.37	-31.96
	21	65.00	-14.47	122.00	-6.15	76.00	5.56	8.73	-15.43	0.36	-20.33	0.42	-23.29
	33	75.00	-1.32	118.00	-9.23	76.00	5.56	7.99	-22.64	0.32	-29.67	0.35	-36.53
	45	76.00	0.00	120.00	-7.69	72.00	0.00	8.13	-21.29	0.33	-26.92	0.35	-36.07
	57	83.00	9.21	118.00	-9.23	76.00	5.56	11.55	11.87	0.49	7.69	0.58	2.74
	100	81.00	6.58					19.25	86.49	1.00	119.23	0.95	73.06
	123	94.00	23.68					22.76	120.49	1.05	131.32	1.11	102.28
	152	90.00	18.42					15.88	53.79	0.81	76.92	0.79	44.75

Subj 13	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
	0	70.00	0.00	124.00	0.00	70.00	0.00	9.91	0.00	0.39	0.00	0.40	0.00
	9	74.00	5.71	132.00	6.45	72.00	2.86	11.83	19.32	0.54	38.96	0.52	28.75
	21	80.00	14.29	132.00	6.45	70.00	0.00	10.87	9.66	0.52	35.71	0.48	20.63
	33	80.00	14.29	126.00	1.61	72.00	2.86	12.28	23.91	0.61	57.14	0.51	26.88
	45	72.00	2.86	128.00	3.23	70.00	0.00	13.10	32.13	0.70	82.47	0.57	42.50
	57	78.00	11.43	128.00	3.23	70.00	0.00	15.57	57.07	0.89	129.87	0.76	90.62
	100	78.00	11.43					17.06	72.08	0.91	136.36	0.84	108.75
	123	78.00	11.43					31.06	213.37	1.29	235.06	1.11	178.13
	152	78.00	11.43					15.74	58.79	0.81	109.09	0.68	70.00

Subj 14	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
	0	60.00	0.00	118.00	0.00	68.00	0.00	9.63	0.00	0.36	0.00	0.33	0.00
	9	62.00	3.33	122.00	3.39	64.00	-5.88	9.79	1.66	0.38	5.63	0.37	11.28
	21	68.00	13.33	128.00	8.47	62.00	-8.82	10.29	6.88	0.43	21.83	0.41	21.80
	33	52.00	-13.33	128.00	8.47	64.00	-5.88	11.78	22.36	0.50	40.85	0.48	45.11
	45	68.00	13.33	118.00	0.00	62.00	-8.82	15.55	61.52	0.51	43.66	0.58	75.19
	57	58.00	-3.33	120.00	1.69	64.00	-5.88	18.34	90.44	0.55	53.52	0.62	86.47
	100	88.00	46.67					37.89	293.56	1.21	239.44	1.35	306.02
	123	68.00	13.33					27.65	187.15	1.13	218.31	1.15	244.36
	152	68.00	13.33					24.23	151.70	0.94	163.38	0.94	182.71

Table 20 (cont.)   Cardiovascular and Respiratory Parameters

Condition 2

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	VO2	%Δ VO2	VCO2	%Δ VCO2
15	0	72.00	0.00	122.00	0.00	70.00	0.00	9.83	0.00	0.40	0.00	0.34	0.00
	9	62.00	-13.89	122.00	0.00	76.00	8.57	12.91	31.33	0.36	-10.69	0.47	37.23
	21	75.00	4.17	124.00	1.64	78.00	11.43	16.56	68.45	0.46	15.09	0.58	68.61
	33	63.00	-12.50	126.00	3.28	80.00	14.29	15.08	53.32	0.47	18.24	0.48	33.58
	45	75.00	4.17	130.00	6.56	80.00	14.29	24.58	149.94	0.69	74.21	0.69	101.46
	57	74.00	2.78	130.00	6.56	88.00	25.71	28.34	188.23	0.73	84.28	0.73	113.14
	100	95.00	31.94					37.43	280.70	1.09	173.58	1.11	222.63
	123	95.00	31.94					33.08	236.46	0.99	149.69	0.82	137.96
	152	73.00	1.39					31.89	224.31	0.86	116.98	0.86	151.82

Table 20 (cont.)   Cardiovascular and Respiratory Parameters

Condition 3

Subj 1 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	76.00	0.00	136.00	0.00	80.00	0.00	12.03	0.00	0.55	0.00	0.97	0.00
9	70.00	-7.89	120.00	-11.76	72.00	-10.00	11.41	-5.18	0.47	-15.84	0.44	-54.90
21	55.00	-27.63	120.00	-11.76	80.00	0.00	10.13	-15.82	0.39	-28.96	0.42	-57.22
33	65.00	-14.47	122.00	-10.29	80.00	0.00	12.64	5.11	0.47	-14.93	0.53	-45.88
45	69.00	-9.21	122.00	-10.29	78.00	-2.50	11.33	-5.80	0.52	-6.79	0.45	-53.61
57	68.00	-10.53	124.00	-8.82	62.00	-22.50	14.56	21.01	0.58	5.43	0.60	-38.14
100	78.00	2.63					16.67	38.60	0.80	44.80	0.76	-21.65
123	76.00	2.63					15.23	26.65	0.72	30.32	0.73	-25.00
152	70.00	-7.89					18.37	52.73	0.83	49.77	0.80	-17.78

Subj 2 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	96.00	0.00	120.00	0.00	70.00	0.00	16.48	0.00	0.46	0.00	0.59	0.00
9	94.00	-2.08	120.00	0.00	62.00	-11.43	17.79	7.95	0.45	-2.72	0.63	7.69
21	77.00	-19.79	122.00	1.67	60.00	-14.29	17.27	4.79	0.39	-16.30	0.61	3.85
33	74.00	-22.92	122.00	1.67	64.00	-8.57	11.41	-30.76	0.33	-29.35	0.44	-25.21
45	82.00	-14.58	120.00	0.00	60.00	-14.29	13.05	-20.83	0.38	-17.39	0.55	-5.56
57	66.00	-31.25	124.00	3.33	62.00	-11.43	16.33	-0.91	0.63	36.96	0.72	22.22
100	78.00	-18.75					25.02	51.81	0.89	93.48	1.05	79.49
123	99.00	3.13					27.32	65.79	1.12	142.93	1.09	86.75
152	89.00	-7.29					28.77	74.59	1.09	136.96	1.13	92.74

Subj 4 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	84.00	0.00	110.00	0.00	60.00	0.00	11.60	0.00	0.47	0.00	0.44	0.00
9	92.00	9.52	114.00	3.64	60.00	0.00	13.82	19.12	0.44	-6.45	0.51	15.91
21	73.00	-13.10	120.00	9.09	60.00	0.00	13.48	16.25	0.42	-9.68	0.55	23.86
33	73.00	-13.10	130.00	18.18	62.00	3.33	14.06	21.19	0.56	19.89	0.56	26.70
45	82.00	-2.38	126.00	14.55	64.00	6.67	15.80	36.19	0.70	50.00	0.71	61.36
57	78.00	-7.14	120.00	9.09	62.00	3.33	17.99	55.12	0.72	55.38	0.80	81.82
100	82.00	-2.38					22.19	91.33	0.81	73.66	1.01	129.55
123	84.00	0.00					19.75	70.32	0.86	83.87	0.91	107.39
152	84.00	0.00					20.31	75.10	0.95	103.23	0.92	109.09

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 3

Subj 5

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	52.00	0.00	120.00	0.00	80.00	0.00	8.03	0.00	0.34	0.00	0.30	0.00
9	58.00	11.54	120.00	0.00	80.00	0.00	12.10	50.72	0.46	38.06	0.46	53.33
21	74.00	42.31	126.00	5.00	80.00	0.00	13.09	63.15	0.35	3.73	0.35	15.83
33	63.00	21.15	120.00	0.00	80.00	0.00	13.65	70.09	0.53	57.46	0.48	60.83
45	73.00	40.38	120.00	0.00	80.00	0.00	14.13	76.07	0.51	51.49	0.44	46.67
57	71.00	36.54	128.00	6.67	80.00	0.00	16.99	111.68	0.64	91.79	0.55	81.67
100	75.00	44.23					19.57	143.89	0.83	147.01	0.77	155.00
123	80.00	53.85					16.18	101.62	0.72	114.93	0.64	114.17
152	75.00	44.23					23.06	187.32	0.50	49.25	0.72	140.83

Subj 6

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	60.00	0.00	122.00	0.00	72.00	0.00	18.09	0.00	0.63	0.00	0.62	0.00
9	58.00	-3.33	130.00	6.56	82.00	13.89	21.90	21.04	0.51	-18.00	0.66	6.05
21	43.00	-28.33	120.00	-1.64	72.00	0.00	17.10	-5.49	0.78	24.40	0.59	-4.84
33	53.00	-11.67	120.00	-1.64	78.00	8.33	14.08	-22.18	0.65	3.20	0.48	-22.18
45	43.00	-28.33	112.00	-8.20	80.00	11.11	14.33	-20.81	0.64	2.40	0.47	-24.19
57	62.00	3.33	112.00	-8.20	80.00	11.11	27.40	51.42	1.07	71.20	0.97	56.45
100	83.00	38.33					36.55	101.99	1.29	106.00	1.11	78.63
123	53.00	-11.67					35.89	97.28	1.12	78.80	0.98	58.06
152	70.00	16.67					35.25	94.82	1.02	62.40	0.87	39.52

Subj 7

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	68.00	124.00	80.00									
9	85.00	120.00	72.00									
21	65.00	122.00	80.00									
33	81.00	114.00	80.00									
45	75.00	120.00	78.00									
57	90.00	114.00	74.00									
100	91.00											
123	95.00											
152	70.00											

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 3

Subj 8

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	88.00	0.00	122.00	0.00	68.00	0.00	12.06	0.00	0.42	0.00	0.33	0.00
9	86.00	-2.27	130.00	6.56	70.00	2.94	11.54	-4.31	0.36	-13.77	0.31	-6.77
21	80.00	-9.09	128.00	4.92	68.00	0.00	11.26	-6.63	0.35	-15.57	0.33	-1.50
33	78.00	-11.36	128.00	4.92	68.00	0.00	13.26	9.97	0.47	12.57	0.40	19.55
45	76.00	-13.64	134.00	9.84	70.00	2.94	13.01	7.92	0.44	5.39	0.39	18.05
57	82.00	-6.82	122.00	0.00	66.00	-2.94	14.37	19.18	0.57	35.33	0.48	42.88
100	92.00	4.55					22.37	85.55	0.90	116.17	0.77	132.33
123	83.00	-5.68					19.80	64.19	0.90	114.37	0.73	118.05
152	85.00	-3.41					18.97	57.29	0.81	92.81	0.66	98.50

Subj 9

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	60.00	0.00	118.00	0.00	70.00	0.00	8.04	0.00	0.33	0.00	0.27	0.00
9	56.00	-6.67	122.00	3.39	70.00	0.00	12.53	55.81	0.40	18.80	0.37	37.04
21	63.00	5.00	122.00	3.39	70.00	0.00	6.96	-13.50	0.27	-18.80	0.22	-17.59
33	66.00	10.00	120.00	1.69	70.00	0.00	8.34	3.78	0.30	-11.28	0.27	0.93
45	62.00	3.33	118.00	0.00	70.00	0.00	16.52	105.44	0.77	131.58	0.56	105.56
57	73.00	21.67	114.00	-3.39	70.00	0.00	17.50	117.63	0.74	121.80	0.49	79.63
100	68.00	13.33					25.10	212.19	0.96	188.72	0.74	174.07
123	95.00	58.33					23.79	195.86	0.95	184.96	0.80	197.22
152	90.00	50.00					21.50	167.41	0.74	121.05	0.67	149.07

Subj 11

Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	92.00	0.00	132.00	0.00	76.00	0.00	14.38	0.00	0.34	0.00	0.56	0.00
9	104.00	13.04	132.00	0.00	80.00	5.26	12.43	-13.56	0.40	19.26	0.51	-8.07
21	110.00	19.57	142.00	7.58	78.00	2.63	13.31	-7.49	0.45	31.85	0.57	1.35
33	102.00	10.87	136.00	3.03	84.00	10.53	13.63	-5.27	0.46	35.56	0.57	2.69
45	98.00	6.52	140.00	6.06	76.00	0.00	15.52	7.93	0.50	46.67	0.67	20.18
57	100.00	8.70	140.00	6.06	80.00	5.26	22.59	57.03	0.80	137.04	1.02	83.41
100	104.00	13.04					23.45	63.05	0.83	144.44	1.01	81.17
123	114.00	23.91					21.94	52.55	0.73	114.81	0.94	67.71
152	114.00	23.91					16.43	14.20	0.57	68.15	0.70	24.66

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 3

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
12	0	72.00	0.00	120.00	0.00	70.00	0.00	9.80	0.00	0.47	0.00	0.41	0.00
	9	78.00	8.33	120.00	0.00	80.00	14.29	9.36	0.69	0.41	-13.30	0.39	-4.91
	21	70.00	-2.78	120.00	0.00	78.00	11.43	11.88	21.31	0.49	4.26	0.48	17.18
	33	84.00	16.67	122.00	1.67	80.00	14.29	8.80	-10.18	0.36	-24.47	0.37	-9.20
	45	72.00	0.00	122.00	1.67	82.00	17.14	11.37	16.08	0.45	-3.72	0.46	13.50
	57	80.00	11.11	126.00	5.00	82.00	17.14	17.23	75.93	0.86	83.51	0.75	84.05
	100	80.00	11.11					23.80	142.93	1.09	131.38	0.84	106.75
	123	90.00	25.00					18.71	90.96	0.67	42.55	0.73	79.75
	152	84.00	16.67					24.22	147.22	0.72	52.13	0.83	102.45

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
13	0	84.00	0.00	134.00	0.00	74.00	0.00	9.48	0.00	0.45	0.00	0.45	0.00
	9	78.00	-7.14	126.00	-5.97	70.00	-5.41	10.54	11.10	0.54	18.23	0.50	11.24
	21	86.00	2.38	124.00	-7.46	70.00	-5.41	11.46	20.80	0.54	19.34	0.49	9.55
	33	78.00	-7.14	126.00	-5.97	68.00	-8.11	10.12	6.75	0.55	21.55	0.49	9.55
	45	82.00	-2.38	122.00	-8.96	66.00	-10.81	10.03	5.80	0.53	17.68	0.50	12.92
	57	84.00	0.00	124.00	-7.46	68.00	-0.11	13.48	42.18	0.69	53.04	0.69	53.93
	100	72.00	-14.29					18.47	94.81	0.96	112.15	0.89	100.56
	123	82.00	-2.38					17.04	79.65	0.77	69.61	0.77	71.91
	152	78.00	-7.14					16.18	70.60	0.83	82.87	0.76	71.35

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
14	0	60.00	0.00	114.00	0.00	70.00	0.00	6.32	0.00	0.30	0.00	0.23	0.00
	9	63.00	5.00	120.00	5.26	64.00	-8.57	9.51	50.63	0.54	79.83	0.38	67.03
	21	61.00	1.67	120.00	5.26	80.00	14.29	7.93	25.61	0.35	15.97	0.27	16.48
	33	62.00	3.33	120.00	5.26	80.00	14.29	9.68	53.21	0.48	61.34	0.33	43.96
	45	55.00	-8.33	118.00	3.51	80.00	14.29	10.04	58.99	0.50	68.91	0.33	43.96
	57	58.00	-3.33	120.00	5.26	82.00	17.14	11.83	87.29	0.56	87.39	0.44	91.21
	100	68.00	13.33					27.35	333.02	1.24	317.65	1.03	351.65
	123	95.00	58.33					22.42	254.99	1.15	285.71	0.88	287.91
	152	78.00	30.00					25.56	304.79	1.24	315.13	0.94	312.09

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 3

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
15	0	80.00	0.00	124.00	0.00	72.00	0.00	12.27	0.00	0.40	0.00	0.42	0.00
	9	85.00	6.25	132.00	6.45	82.00	13.89	10.73	-12.54	0.36	-11.80	0.38	-9.58
	21	75.00	-6.25	132.00	6.45	84.00	16.67	12.53	2.16	0.37	-8.07	0.44	4.79
	33	72.00	-10.00	132.00	6.45	84.00	16.67	12.50	1.88	0.36	-9.94	0.40	-3.59
	45	70.00	-12.50	128.00	3.23	82.00	13.89	21.81	77.78	0.69	70.19	0.75	79.64
	57	75.00	-6.25	126.00	1.61	80.00	11.11	27.01	120.18	0.68	68.94	0.76	82.04
	100	94.00	17.50					34.51	181.39	1.09	171.43	1.24	197.01
	123	90.00	12.50					46.67	280.53	0.67	66.46	1.34	219.76
	152	101.00	26.25					36.71	199.31	0.73	81.37	1.22	191.02

Table 20 (cont.)   Cardiovascular and Respiratory Parameters

Condition 4

Subj 1 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	81.00	0.00	132.00	0.00	74.00	0.00	11.28	0.00	0.54	0.00	0.45	0.00
9	93.00	14.81	126.00	-4.55	70.00	-5.41	17.79	57.73	0.53	-1.85	0.63	40.78
21	140.00	72.84	210.00	59.09	64.00	-13.51	87.96	679.96	3.69	583.80	3.55	693.85
33	101.00	24.69	144.00	9.09	40.00	-45.95	12.27	8.78	0.45	-17.13	0.40	-10.61
45	144.00	77.78	184.00	39.39	60.00	-18.92	79.10	601.40	3.08	470.37	3.35	647.49
57	108.00	33.33	130.00	-1.52	60.00	-18.92	17.44	54.60	0.88	62.96	0.71	58.66
100	95.00	17.28					21.11	87.16	0.89	64.35	0.86	91.06
123	96.00	18.52					23.58	109.07	1.05	93.52	0.96	115.08
152	93.00	14.81					29.19	158.83	1.07	98.61	1.09	142.46

Subj 2 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	80.00	0.00	120.00	0.00	70.00	0.00	17.64	0.00	0.52	0.00	0.53	0.00
9	65.00	-18.75	120.00	0.00	80.00	14.29	15.73	-10.84	0.53	2.43	0.56	5.71
21	156.00	95.00	172.00	43.33	68.00	-2.86	57.86	227.99	2.40	365.05	2.73	420.00
33	109.00	36.25	128.00	6.57	66.00	-5.71	18.62	5.53	0.54	5.34	0.63	20.00
45	154.00	92.50	168.00	40.00	68.00	-2.86	45.29	156.72	2.03	294.66	2.13	306.19
57	100.00	25.00	126.00	5.00	68.00	-2.86	15.75	-10.70	0.54	4.85	0.56	6.19
100	101.00	26.25					27.65	56.72	1.12	116.99	1.19	127.14
123	85.00	6.25					31.50	78.54	1.28	147.57	1.34	154.29
152	95.00	18.75					42.11	138.72	1.48	187.86	1.59	202.86

Subj 4 Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
0	80.00	0.00	122.00	0.00	68.00	0.00	13.25	0.00	0.55	0.00	0.53	0.00
9	85.00	6.25	130.00	6.56	64.00	-5.88	10.86	-18.03	0.59	7.31	0.48	-8.57
21	160.00	100.00	162.00	32.79	64.00	-5.88	55.56	319.44	2.70	392.69	2.81	434.29
33	95.00	18.75	124.00	1.64	64.00	-5.88	9.41	-28.99	0.47	-15.07	0.41	-22.86
45	152.00	90.00	174.00	42.62	64.00	-5.88	65.07	391.24	3.57	551.60	3.37	541.90
57	91.00	13.75	120.00	-1.64	64.00	-5.88	10.32	-22.12	0.40	-27.85	0.35	-33.81
100	87.00	8.75					16.21	22.37	0.76	38.36	0.71	35.24
123	85.00	6.25					24.10	81.94	0.94	71.23	0.91	72.38
152	89.00	11.25					19.15	44.58	0.83	50.68	0.78	48.10

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 4

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
5	0	68.00	0.00	130.00	0.00	70.00	0.00	6.31	0.00	0.27	0.00	0.25	0.00
	9	65.00	-4.41	130.00	0.00	74.00	5.71	5.87	-6.98	0.21	-22.22	0.24	-3.96
	21	174.00	155.88	180.00	38.46	70.00	0.00	43.23	585.65	1.48	448.15	1.93	665.35
	33	98.00	44.12	140.00	7.69	78.00	11.43	7.26	15.11	0.26	-3.70	0.32	26.73
	45	155.00	127.94	188.00	44.62	74.00	5.71	38.33	507.85	1.54	469.44	1.88	644.55
	57	100.00	47.06	148.00	13.85	80.00	14.29	10.72	69.94	0.36	33.33	0.47	84.16
	100	95.00	39.71					24.38	286.64	0.85	213.89	0.87	245.54
	123	110.00	61.76					18.85	198.97	0.67	148.15	0.60	138.61
	152	97.00	42.65					23.37	270.66	0.75	178.70	0.79	211.88
6	0	54.00	0.00	120.00	0.00	72.00	0.00	17.66	0.00	0.42	0.00	0.62	0.00
	9	65.00	20.37	124.00	3.33	62.00	-13.89	14.88	-15.73	0.43	3.61	0.46	-26.32
	21	150.00	177.78	172.00	43.33	62.00	-13.89	87.99	398.36	2.76	565.66	3.43	455.87
	33	75.00	38.89	110.00	-8.33	70.00	-2.78	22.94	29.95	0.52	25.90	0.70	13.36
	45	149.00	175.93	180.00	50.00	62.00	-13.89	72.31	309.57	3.09	645.18	2.95	378.14
	57	89.00	64.81	110.00	-8.33	72.00	0.00	21.84	23.70	0.67	61.45	0.57	8.91
	100	79.00	46.30					41.59	135.54	1.32	217.47	1.22	97.57
	123	99.00	83.33					42.09	138.40	1.31	215.06	1.21	95.95
	152	62.00	14.81					37.84	114.33	0.91	118.07	0.90	46.15
7	0	80.00	0.00	122.00	0.00	70.00	0.00	12.48	0.00	0.58	0.00	0.60	0.00
	9	86.00	7.50	120.00	-1.64	70.00	0.00	12.38	-0.82	0.57	-2.16	0.55	-7.14
	21	152.00	90.00	158.00	29.51	62.00	-11.43	55.45	344.18	2.30	297.40	2.73	359.24
	33	95.00	18.75	122.00	0.00	70.00	0.00	7.82	-37.33	0.42	-28.14	0.36	-40.34
	45	152.00	90.00	174.00	42.62	60.00	-14.29	45.29	262.79	2.24	288.31	2.53	324.79
	57	94.00	17.50	122.00	0.00	64.00	-8.57	6.35	-49.13	0.35	-39.83	0.30	-50.00
	100	108.00	35.00					14.20	13.74	0.59	2.60	0.68	13.45
	123	89.00	11.25					18.45	47.81	0.94	62.77	1.00	68.07
	152	101.00	26.25					6.35	-49.13	0.35	-39.83	0.30	-50.00

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition A

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
8	0	68.00	0.00	118.00	0.00	68.00	0.00	13.04	0.00	0.41	0.00	0.40	0.00
	9	82.00	20.59	120.00	1.69	68.00	0.00	13.70	5.08	0.45	10.49	0.44	8.75
	21	148.00	117.65	164.00	38.98	70.00	2.94	46.74	258.44	1.67	312.35	1.79	346.88
	33	94.00	38.24	128.00	8.47	68.00	0.00	16.20	24.2?	0.61	51.23	0.51	26.88
	45	148.00	117.65	168.00	42.37	68.00	0.00	51.17	292.39	2.10	417.90	1.97	393.13
	57	94.00	38.24	128.00	8.47	70.00	2.94	14.41	10.53	0.54	33.95	0.43	7.50
	100	84.00	23.53					19.67	50.82	0.75	83.95	0.68	70.62
	123	88.00	29.41					23.50	80.21	0.95	135.19	0.86	115.63
	152	94.00	38.24					21.24	62.85	0.87	113.58	0.80	99.38
9	0	64.00	0.00	114.00	0.00	64.00	0.00	13.26	0.00	0.42	0.00	0.46	0.00
	9	60.00	-6.25	116.00	1.75	64.00	0.00	16.88	27.30	0.36	-14.20	0.48	3.83
	21	137.00	114.06	184.00	61.40	72.00	12.50	56.63	327.06	2.45	479.88	2.74	497.81
	33	83.00	29.69	118.00	3.51	66.00	3.13	15.14	14.14	0.40	-4.73	0.47	2.19
	45	141.00	120.31	188.00	64.91	72.00	12.50	53.57	303.98	2.28	440.24	2.36	415.85
	57	93.00	45.31	114.00	0.00	64.00	0.00	18.62	40.42	0.46	8.88	0.56	21.86
	100	85.00	32.81					25.95	95.70	0.79	87.57	0.75	63.93
	123	82.00	28.13					28.49	114.88	0.78	83.43	0.81	77.60
	152	90.00	40.63					30.23	127.96	0.91	115.98	0.83	80.87
11	0	76.00	0.00	132.00	0.00	74.00	0.00	12.74	0.00	0.43	0.00	0.40	0.00
	9	92.00	21.05	134.00	1.52	76.00	2.70	12.38	-2.77	0.37	-15.61	0.40	0.62
	21	148.00	94.74	172.00	30.30	74.00	0.00	39.11	207.07	1.79	312.72	1.77	341.25
	33	102.00	34.21	132.00	0.00	74.00	0.00	14.08	10.52	0.50	15.03	0.45	11.25
	45	156.00	105.26	176.00	33.33	76.00	2.70	45.83	259.89	2.04	372.25	2.01	401.88
	57	104.00	36.84	132.00	0.00	76.00	2.70	14.29	12.23	0.50	14.45	0.48	20.63
	100	114.00	50.00					21.18	66.31	0.77	76.88	0.82	104.38
	123	112.00	47.37					24.17	89.79	0.96	120.81	0.88	120.00
	152	106.00	39.47					27.21	113.66	1.07	147.98	1.04	159.38

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 4

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
12	0	80.00	0.00	125.00	0.00	60.00	0.00	12.87	0.00	0.40	0.00	0.57	0.00
	9	77.00	-3.75	128.00	0.00	72.00	20.00	11.43	-11.19	0.47	16.77	0.47	-17.26
	21	165.00	106.25	200.00	56.25	64.00	6.67	57.98	350.55	2.10	420.50	2.74	364.51
	33	95.00	18.75	128.00	0.00	72.00	20.00	10.03	-22.09	0.47	15.53	0.40	-29.65
	45	173.00	116.25	198.00	54.69	58.00	-3.33	63.78	395.63	2.80	595.03	3.05	440.27
	57	100.00	25.00	120.00	-6.25	70.00	16.67	8.59	-33.28	0.39	-4.35	0.34	-39.82
	100	77.00	-3.75					12.68	-1.50	0.51	25.47	0.55	-3.10
	123	74.00	-7.50					15.24	18.42	0.63	55.28	0.68	20.35
	152	73.00	-8.75					13.28	3.19	0.40	-1.24	0.52	-8.85
13	0	72.00	0.00	132.00	0.00	70.00	0.00	9.37	0.00	0.43	0.00	0.45	0.00
	9	86.00	19.44	138.00	4.55	74.00	5.71	8.91	-4.86	0.44	2.94	0.39	-13.26
	21	157.00	118.06	172.00	30.30	72.00	2.86	42.09	349.44	2.15	404.71	2.32	413.26
	33	80.00	11.11	132.00	0.00	72.00	2.86	11.72	25.09	0.59	37.65	0.52	14.36
	45	153.00	112.50	174.00	31.82	70.00	0.00	54.65	483.50	2.83	564.72	3.04	570.72
	57	82.00	13.89	136.00	3.03	72.00	2.86	9.56	2.06	0.47	9.41	0.42	-8.29
	100	82.00	13.89					10.58	12.97	0.61	44.12	0.55	22.10
	123	78.00	8.33					19.47	107.93	0.98	129.41	0.94	108.29
	152	82.00	13.89					14.05	50.05	0.85	98.82	0.77	69.61
14	0	60.00	0.00	120.00	0.00	68.00	0.00	9.98	0.00	0.47	0.00	0.37	0.00
	9	84.00	40.00	118.00	-1.67	62.00	-8.82	12.15	21.80	0.53	11.64	0.44	20.41
	21	137.00	128.33	180.00	50.00	60.00	-11.76	94.15	843.62	3.95	735.45	3.96	976.19
	33	63.00	5.00	110.00	-8.33	70.00	2.94	10.67	6.94	0.45	-4.76	0.35	-4.08
	45	137.00	128.33	160.00	33.33	60.00	-11.76	85.88	760.76	3.81	706.35	3.57	870.75
	57	60.00	0.00	116.00	-3.33	62.00	-8.82	11.12	11.40	0.54	13.76	0.38	4.08
	100	69.00	15.00					24.46	145.15	1.11	134.92	0.94	155.78
	123	69.00	15.00					26.19	162.52	1.29	172.49	1.06	188.44
	152	63.00	5.00					26.27	163.24	1.40	195.77	1.09	196.60

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 4

Subj 15	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	74.00	0.00	122.00	0.00	70.00	0.00	10.89	0.00	0.30	0.00	0.31	0.00
	9	88.00	18.92	128.00	4.92	70.00	0.00	18.57	70.44	0.46	51.24	0.63	102.42
	21	160.00	116.22	168.00	37.70	74.00	5.71	76.82	605.21	3.01	895.87	3.32	969.35
	33	90.00	21.62	120.00	-1.64	70.00	0.00	21.93	101.33	0.41	34.71	0.61	97.58
	45	164.00	121.62	170.00	39.34	70.00	0.00	74.01	579.48	2.96	876.86	3.26	951.61
	57	94.00	27.03	124.00	1.64	68.00	-2.86	21.67	98.94	0.37	22.31	0.59	89.52
	100	72.00	-2.70					30.55	180.45	0.68	124.79	0.92	196.77
	123	70.00	-5.41					41.63	282.14	0.93	207.44	1.04	236.29
	152	72.00	-2.70					38.14	250.13	0.81	166.12	0.97	212.10

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 5

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
1	0	76.00	0.00	128.00	0.00	67.00	0.00	9.24	0.00	0.40	0.00	0.40	0.00
	9	73.00	-3.95	128.00	0.00	80.00	19.40	12.15	31.44	0.58	44.72	0.54	33.54
	21	154.00	102.63	184.00	43.75	60.00	-10.45	74.15	702.52	2.83	602.48	3.44	755.28
	33	86.00	13.16	122.00	-4.69	70.00	4.48	11.75	27.16	0.48	19.88	0.51	26.09
	45	158.00	107.89	180.00	40.63	58.00	-13.43	47.73	416.53	2.07	414.91	2.28	465.22
	57	95.00	25.00	130.00	1.56	68.00	1.49	11.81	27.79	0.49	21.74	0.50	22.98
	100	75.00	-1.32					21.63	134.04	1.04	158.39	0.98	143.48
	123	95.00	25.00					21.96	137.61	1.09	171.43	1.06	162.73
	152	78.00	2.63					17.42	88.53	0.74	82.61	0.80	98.14
2	0	68.00	0.00	120.00	0.00	72.00	0.00	17.11		0.65		0.67	
	9	68.00	0.00	118.00	-1.67	80.00	11.11						
	21	158.00	132.35	154.00	28.33	74.00	2.78	63.32		2.56		2.77	
	33	100.00	47.06	120.00	0.00	78.00	8.33	14.43		0.53		0.54	
	45	156.00	129.41	164.00	36.67	72.00	0.00	62.94		2.57		3.01	
	57	110.00	61.76	118.00	-1.67	74.00	2.78	18.27		0.60		0.58	
	100	106.00	55.88					31.27		1.13		1.26	
	123	96.00	41.18					31.72		1.30		1.24	
	152	110.00	61.76					26.35		1.06		1.06	
4	0	80.00	0.00	118.00	0.00	60.00	0.00	11.75	0.00	0.42	0.00	0.44	0.00
	9	87.00	8.75	124.00	5.08	70.00	16.67	12.12	3.11	0.48	14.46	0.55	26.44
	21	154.00	92.50	180.00	52.54	60.00	0.00	62.90	435.21	2.92	602.41	3.28	653.45
	33	100.00	25.00	122.00	3.39	70.00	16.67	11.07	-5.81	0.43	2.41	0.45	2.30
	45	157.00	96.25	200.00	69.49	60.00	0.00	58.16	394.87	2.76	564.46	3.06	602.30
	57	100.00	25.00	122.00	3.39	70.00	16.67	10.09	-14.15	0.36	-13.25	0.40	-9.20
	100	100.00	25.00					25.95	120.80	1.14	173.49	1.22	179.31
	123	87.00	8.75					23.30	98.21	0.30	-28.92	0.39	-10.34
	152	85.00	6.25					29.43	150.41	0.63	51.81	1.03	136.21

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 5

Subj 5	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	60.00	0.00	112.00	0.00	70.00	0.00	8.82	0.00	0.38	0.00	0.37	0.00
	9	65.00	8.33	112.00	0.00	70.00	0.00	9.17	3.94	0.31	-17.76	0.32	-13.51
	21	156.00	160.00	174.00	55.36	60.00	-14.29	54.73	520.70	2.24	488.82	2.50	575.68
	33	97.00	61.67	126.00	12.50	70.00	0.00	13.06	48.14	0.47	24.34	0.45	20.95
	45	154.00	156.67	205.00	83.04	58.00	-17.14	41.56	371.34	1.81	375.00	1.87	405.41
	57	105.00	75.00	128.00	14.29	70.00	0.00	13.60	54.18	0.57	50.00	0.46	25.00
	100	96.00	60.00					20.68	134.56	0.72	89.47	0.66	77.70
	123	106.00	76.67					22.26	152.48	0.77	101.97	0.73	97.97
	152	77.00	28.33					18.90	114.37	0.66	73.03	0.65	75.00

Subj 6	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	44.00	0.00	120.00	0.00	64.00	0.00	16.81	0.00	0.52	0.~	0.54	0.00
	9	48.00	9.09	128.00	6.67	66.00	3.13	19.09	13.58	0.37	-28.85	0.52	-2.80
	21	153.00	247.73	160.00	33.33	60.00	-6.25	71.32	324.41	2.39	358.65	2.73	410.28
	33	82.00	86.36	138.00	15.00	66.00	3.13	12.77	-24.01	0.40	-23.56	0.36	-33.64
	45	150.00	240.91	182.00	51.67	70.00	9.38	90.82	440.40	3.27	529.33	3.27	510.75
	57	78.00	77.27	128.00	6.67	68.00	6.25	20.41	21.45	0.44	-16.35	0.49	-7.94
	100	72.00	63.64					30.19	79.66	0.54	4.33	0.72	34.11
	123	52.00	18.18					35.22	109.57	0.98	73.56	0.97	80.37
	152	56.00	27.27					30.23	79.90	0.67	27.88	0.80	50.00

Subj 7	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	80.00	0.00	128.00	0.00	70.00	0.00	15.55	0.00	0.50	0.00	0.52	0.00
	9	78.00	-2.50	120.00	-6.25	72.00	2.86	12.48	-19.76	0.34	-32.00	0.35	-32.52
	21	150.00	87.50	164.00	28.13	68.00	-2.86	64.73	316.25	2.85	469.50	2.93	468.45
	33	96.00	20.00	118.00	-7.81	68.00	-2.86	8.68	-44.16	0.33	-34.50	0.31	-39.32
	45	125.00	56.25	164.00	28.13	60.00	-14.29	49.58	218.81	2.26	351.50	2.50	385.92
	57	85.00	6.25	120.00	-6.25	64.00	-0.57	6.50	-58.23	0.26	-48.50	0.25	-50.97
	100	100.00	25.00					26.27	68.94	1.23	145.00	1.16	124.27
	123	110.00	37.50					24.55	57.89	1.21	141.00	1.13	119.90
	152	100.00	25.00					23.41	50.51	1.19	137.50	1.15	122.82

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 5

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
8	0	60.00	0.00	120.00	0.00	70.00	0.00	10.78	0.00	0.38	0.00	0.36	0.00
	9	77.00	28.33	120.00	0.00	72.00	2.86	10.53	-2.32	0.36	-5.30	0.35	-3.50
	21	136.00	126.67	168.00	40.00	60.00	-14.29	40.24	273.32	1.45	282.78	1.52	325.87
	33	88.00	46.67	128.00	6.67	68.00	-2.86	14.34	35.84	0.52	36.42	0.44	22.38
	45	135.00	125.00	172.00	43.33	62.00	-11.43	31.71	203.48	1.16	207.28	1.21	238.46
	57	92.00	53.33	120.00	0.00	70.00	0.00	11.66	8.19	0.36	-5.96	0.32	-9.79
	100	79.00	31.67					20.82	93.20	0.85	124.50	0.76	111.89
	123	85.00	41.67					28.46	145.47	0.99	162.25	1.11	211.19
	152	78.00	30.00					24.40	126.35	0.75	99.34	0.91	153.15

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
9	0	68.00	0.00	118.00	0.00	68.00	0.00	8.95	0.00	0.26	0.00	0.27	0.00
	9	72.00	5.88	116.00	-1.69	68.00	0.00	13.28	48.46	0.51	98.04	0.46	68.52
	21	146.00	114.71	170.00	44.07	66.00	-2.94	57.15	538.85	2.42	849.02	2.69	897.22
	33	92.00	35.29	118.00	0.00	65.00	-2.94	9.79	9.39	0.38	48.04	0.33	21.30
	45	146.00	114.71	172.00	45.76	66.00	-2.94	52.95	491.89	2.26	785.29	2.42	795.37
	57	82.00	20.59	120.00	1.69	70.00	2.94	14.08	57.43	0.52	101.96	0.50	83.33
	100	84.00	23.53					36.93	312.86	0.97	280.39	1.15	324.07
	123	94.00	38.24					33.51	274.59	0.94	267.65	1.11	311.11
	152	82.00	20.59					27.95	212.44	0.91	254.90	0.93	243.52

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
11	0	88.00	0.00	132.00	0.00	80.00	0.00	11.35	0.00	0.35	0.00	0.43	0.00
	9	94.00	6.82	120.00	-9.09	80.00	0.00	10.42	-8.22	0.31	-12.86	0.38	-11.56
	21	154.00	75.00	154.00	16.67	68.00	-15.00	52.80	365.28	1.68	380.00	2.38	450.87
	33	107.00	21.59	132.00	0.00	76.00	-5.00	10.66	-6.06	0.37	6.43	0.37	-15.03
	45	149.00	69.32	160.00	21.21	80.00	0.00	45.78	303.39	1.69	381.43	1.98	356.65
	57	110.00	25.00	130.00	-1.52	74.00	-7.50	10.07	-11.26	0.37	6.43	0.34	-22.54
	100	125.00	42.05					14.37	26.64	0.50	43.57	0.58	34.68
	123	93.00	5.68					19.28	69.86	0.88	150.71	0.81	87.28
	152	109.00	23.86					20.87	83.90	0.85	143.57	0.81	87.28

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 5

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
12	0	80.00	0.00	128.00	0.00	72.00	0.00	11.10	0.00	0.46	0.00	0.51	0.00
	9	78.00	-2.50	120.00	-6.25	80.00	11.11	7.37	-33.60	0.35	-24.04	0.35	-30.69
	21	156.00	95.00	184.00	43.75	60.00	-16.67	94.18	748.28	8.77	724.04	4.40	770.79
	33	85.00	6.25	120.00	-6.25	80.00	11.11	11.21	0.97	0.49	6.01	0.47	-7.92
	45	158.00		180.00	40.63	60.00	-16.67	67.43	507.34	2.93	539.89	3.30	553.96
	57	99		20.00	-6.25	60.00	-16.67	8.95	-19.41	0.46	0.55	0.47	-6.93
	100		5					13.14	18.37	0.59	29.51	0.64	26.24
	123		-7.50					10.75	-3.22	0.51	11.48	0.52	3.47
	152		2.					15.67	41.16	0.76	65.57	0.76	50.00

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
13	0	72.00	0.00	124.00	0.00	68.00	0.00	9.23	0.00	0.39	0.00	0.40	0.00
	9	70.00	-2.78	128.00	3.23	66.00	-2.94	9.82	6.31	0.42	7.69	0.40	0.00
	21	155.00	115.28	166.00	33.87	70.00	2.94	56.42	511.05	2.26	480.13	2.67	574.68
	33	94.00	30.56	126.00	1.61	68.00	0.00	11.17	20.93	0.41	5.77	0.41	3.16
	45	156.00	116.67	170.00	37.10	70.00	2.94	49.26	433.50	2.14	448.08	2.37	499.37
	57	90.00	25.00	130.00	4.84	68.00	0.00	11.11	20.31	0.49	24.36	0.46	15.82
	100	88.00	22.22					18.40	99.24	0.77	98.08	0.80	101.27
	123	92.00	27.78					30.78	233.33	0.90	130.13	0.99	151.27
	152	96.00	33.33					22.77	146.63	0.83	112.18	0.81	105.70

Subj	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
14	0	60.00	0.00	118.00	0.00	80.00	0.00	8.99	0.00	0.38	0.00	0.33	0.00
	9	65.00	8.33	118.00	0.00	74.00	-7.50	12.53	39.36	0.50	31.58	0.43	29.32
	21	148.00	146.67	142.00	20.34	68.00	-15.00	99.10	#####	3.95	939.47	3.93	#####
	33	85.00	41.67	128.00	8.47	84.00	5.00	10.54	17.25	0.43	13.82	0.33	-0.75
	45	130.00	116.67	140.00	18.64	70.00	-12.50	86.62	863.76	3.60	848.03	3.46	941.35
	57	83.00	38.33	120.00	1.69	70.00	-12.50	12.82	42.64	0.53	38.82	0.40	18.80
	100	85.00	41.67					21.37	137.77	0.98	158.55	0.83	148.12
	123	74.00	23.33					27.63	207.40	1.24	226.32	1.03	209.02
	152	73.00	21.67					23.20	158.11	1.09	186.18	0.89	167.67

Table 20 (cont.) Cardiovascular and Respiratory Parameters

Condition 5

Subj 15	Time (min)	HR	%Δ HR	Systolic	%Δ Systolic	Diastolic	%Δ Diastolic	VE	%Δ VE	RR	%Δ RR	VCO2	%Δ VCO2
	0	72.00	0.00	114.00	0.00	70.00	0.00	12.13	0.00	0.42	0.00	0.38	0.00
	9	63.00	-12.50	114.00	0.00	74.00	5.71	14.12	16.41	0.36	-14.20	0.41	7.19
	21	155.00	115.28	172.00	50.88	80.00	-14.29	86.38	612.43	3.10	633.73	3.22	742.48
	33	99.00	37.50	130.00	14.04	74.00	5.71	30.07	147.96	0.63	47.93	0.75	95.42
	45	162.00	125.00	178.00	56.14	62.00	-11.43	77.29	537.40	2.73	546.75	2.75	617.65
	57	82.00	13.89	138.00	21.05	78.00	11.43	37.22	206.97	0.51	19.53	0.73	90.20
	100	83.00	15.28					35.46	192.47	1.01	138.46	1.00	160.13
	123	100.00	38.89					36.24	198.87	1.07	153.25	1.08	181.05
	152	91.00	26.39					31.23	157.55	0.88	108.28	0.83	117.65

APPENDIX II

Photo 1. Placement of EMG, ECG and temperature electrodes.

Photo 2. Grip strength testing prior to cold exposure.

Photo 3. Exercise with cardiovascular and respiratory **measurements.**

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Photo 4. Shooting, using Firearms Training System (F.A.T.S.).

Photo 5. Complex Cognitive Assessment Battery(CCAB) testing.

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