THE LONGITUDINAL STUDY OF ASTRONAUT HEALTH

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Visual Acuity Changes in Shuttle Astronauts

Spaceflight experience and its resultant weightlessness cause various effects on the human body (*e.g.*, facial fullness, bone density loss). The effect of microgravity on the eye and on visual acuity is a major focus of interest.

In normal vision (20/20), the cornea and the crystalline lens work together to focus the image on the fovea of the retina (Figure 1). This image is transformed into nerve impulses which are then transmitted by the optic nerve into the brain. Blurry vision results when refractive errors cause the light rays to not be focused on the retina. For example, the anomalous curvature of the cornea can cause myopia (nearsightedness), hyperopia (farsightedness), or astigmatism, whereas the loss of lens elasticity causes presbyopia (age-associated farsightedness).

The R+3 (three days post-landing) eye examinations in the period between July 1995 to May 1998 were examined, capturing the results of 122 crewmembers in 21 shuttle missions and five MIR missions (Table 1). Data from the five long-duration MIR crewmembers were not compared against data from Shuttle crewmembers because of the small number.

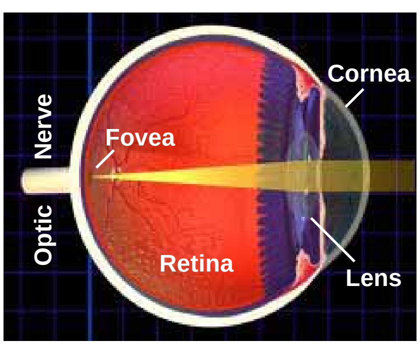

Figure 1

The subjective findings reflect ocular problems experienced inflight by crewmembers, while the objective findings are ocular conditions encountered by the optometrist at the R+3 examination. The most frequently reported subjective finding is decreased near vision acuity (NVA). About 15% of the Shuttle astronauts in this data set perceived this symptom during flight. Objectively, the condition most often recorded during the postflight examination is change in refraction, although not to the

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Table 1. SHUTTLE POSTFLIGHT OCULAR FINDINGS

SUBJECTIVE FINDINGS (INFLIGHT PROBLEMS)	PERCENT (N=122)
Perceived Decreased Distant Vision Acuity	5.7
Perceived Increased Distant Vision Acuity	7.4
Perceived Decreased Near Vision Acuity	15.6
Perceived Increased Near Vision Acuity	2.5
Eye Strain	3.3
Eye Irritation	9.0
Headache	2.5
Dry Eye	1.6
Foreign Body	5.7
Poor Air Quality	10.7
OBJECTIVE FINDINGS (POSTFLIGHT EXAM)	
Keratitis	3.3
Subconjunctival Hemorrhage	0.8
Conjunctivitis	1.6
Change in Refraction (ability of eye to focus light rays)	9.8
Change in Phoria (eye teaming or coordination)	1.6
Change in Accomodation (ability of eye to adjust to various distances)	3.3
Other	3.3

The Comprehensive Medical Information System

Implementation of the Comprehensive Medical Information System (CMIS) has begun! The CMIS project will integrate medically related data from the various sources of space flight Medical Operations into a single system electronic format. The foundation of the system is an electronic medical record (EMR), a computer information system that allows for optimal storage, processing and retrieval of medical information. For example, laboratory test results are located in a ‘flowsheet’ where the physician can look at one value or several values over a defined period of time; these results can be displayed either numerically or graphically. By using an EMR, the Clinics can increase accessibility of pertinent medical data, simplify the input process, decrease paper and redundancy, and increase efficiency in locating and handling patient records.

The integrity and confidentiality of the EMR is a critical issue being addressed by the CMIS Project Team, as well as the Information Systems and the Space and Life Sciences Directorates within NASA. Preliminary plans to protect the data include limiting access to the CMIS network by physically isolating it from the main JSC InterNetwork and other networks. Secure password protection strategies at both the operating system and the EMR application level will be used to authenticate users and control access to the EMR. As the project develops, additional security measures (*e.g.*, data encryption, network monitor-

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What is the Healthy Weight for You?

Now that we have recovered from our holiday indulgences, many of us will probably inventory the damage we have done to our bodies. However, how should you determine the healthy weight for you? It is not simply a matter of looking at a height-weight chart anymore (Tables 1 and 2). Although your weight for height is important, it is not the whole story. The amount of bone, muscle and fat tells much more about body composition. The amount and the distribution of fat you carry are the critical measurements.

A good indicator of how much fat you carry is the body mass index (BMI). Although not a perfect measure, your BMI will give you a fairly accurate assessment of how much of your body is composed of fat. To calculate your BMI, do the following:

- Take your weight in pounds**,** and divide by 2.2 to get your weight in kilograms. Round to the nearest kilogram; this is your **weight number**
- Take your height in inches; multiply the inches by 0.0254 to get your height in meters
- Square your height (multiply it by itself); this is your **height number**
- Divide your **weight number** by your **height number**
- A BMI between 20-24 is considered normal weight. A BMI between 25-29 is considered overweight. Anything over 30 is obese, and under 19 is underweight.

Where you carry your weight also has significance for your health. The waist-to-hip ratio (WHR) is one of the most commonly used anthropometric measures to indicate a central obesity pattern and an increased risk of cardiovascular disease in normal-weight adults. It is calculated by dividing your waist circumference by your hip circumference. A healthy waist/hip ratio is 0.80 or below for women, and 0.95 or below for men. For medical research, central obesity is defined as a WHR greater than 0.80 for women and greater than 0.95 for men. A lower WHR reflects a "pear" distribution

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Table 1. Male Height-Weight Chart

Height (feet/inches)	Small Frame (pounds)	Medium Frame (pounds)	Large Frame (pounds)
5' 2"	128-134	131-141	138-150
5' 3"	130-136	133-143	140-153
5' 4"	132-138	135-145	142-156
5' 5"	134-140	137-148	144-160
5' 6"	136-142	139-151	146-164
5' 7"	140-148	142-154	149-168
5' 8"	142-151	145-157	152-172
5' 9"	144-154	148-157	155-176
5' 10"	146-157	151-163	158-180
5' 11"	149-160	154-166	161-184
6' 0"	152-164	157-170	164-188
6' 1"	155-168	160-174	168-192
6' 2"	155-168	164-178	172-197
6' 3"	158-172	167-182	176-202
6' 4"	162-176	171-187	181-207

From: Metropolitan Life Insurance Company, 1996
Weights at ages 25-59 based on lowest mortality. Values include 5 pounds of indoor clothing and shoes with 1" heels.

Table 2. Female Height-Weight Chart

Height (feet/inches)	Small Frame (pounds)	Medium Frame (pounds)	Large Frame (pounds)
4' 10"	102-111	109-121	118-131
4' 11"	103-113	111-123	120-134
5' 0"	104-115	113-126	122-137
5' 1"	106-118	115-129	125-140
5' 2"	108-121	118-132	128-143
5' 3"	111-124	121-135	131-147
5' 4"	114-127	124-138	134-151
5' 5"	117-130	127-141	137-155
5' 6"	120-133	130-144	140-159
5' 7"	123-136	133-147	143-163
5' 8"	126-139	136-150	146-167
5' 9"	129-142	139-153	149-170
5' 10"	132-145	142-156	152-173
5' 11"	135-148	145-159	155-176
6' 0"	138-151	148-162	158-179

From: Metropolitan Life Insurance Company, 1996
Weights at ages 25-59 based on lowest mortality. Values include 3 pounds of indoor clothing and shoes with 1" heels.

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extent of subjective reportings.

These post-landing data obviously can not capture microgravity conditions. However, the perceived decreased vision acuity may be caused by a change in the shape of the eye, so that light rays refracted by the cornea and lens do not focus on the retina. This shape change may stem from either or both of the following factors:

- lack of gravitational pull along the z-axis (head-to-toe line)
- engorgement of blood vessels behind the retina as a result of bodily fluid redistribution.

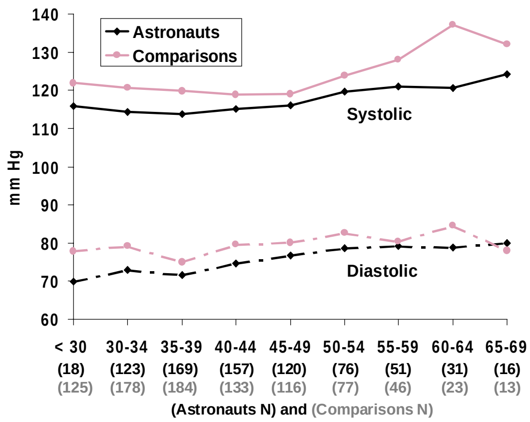
Changes in the shape of the eye do not exclusively account for changes in near vision. However, any change in NVA is more noticeable than changes in distant vision acuity, as most astronaut tasks involve near distances. Currently, about half of the astronauts with decreased near vision acuity report adjustment back to 1-G NVA while inflight, while the other half report no such adjustment.

These preliminary results suggest that changes in visual acuity may be the main ocular issue facing future missions, especially those involving long-term weightlessness. Further research should examine the whole Shuttle flight experience, and the association between mission length and changes in visual acuity. ■

Aging and Blood Pressure

A decline in cardiovascular function is expected with aging in the general population. Systolic and diastolic blood pressure measurements were examined to describe the effects of aging on the cardiovascular function of the LSAH population. Astronauts and comparison participants who were selected before 1992 were included in these analyses. Blood pressures were taken while the participant was seated and were a part of routine physical examinations. Ages were divided into five-year groupings beginning with less than 30 and up to 69 years. Data for men and women are combined for these analyses. An individual is included once in each of the five-year age group for which he/she is eligible, using the first examination for the participant after he/she entered that age group. There are small numbers of participants in the age groups above 55 and the resulting statistics for the older groups may not be stable.

Figure 1. Mean Sitting Blood Pressure for LSAH Participants Selected from 1959 through 1992, by 5 Year Age Groups



The mean systolic and diastolic blood pressures are shown in Figure 1. Although the means for some of the age groups are not statistically different, overall the comparison participants have higher mean blood pressures than the astronauts. These differences may be due to differences in physical activity. The lower mean blood pressures are an indicator of better cardiac conditioning among the astronauts than among the comparison participants as a group. The ranges of individual measurements among the two groups do, however, overlap. These values also indicate that both the astronauts and the comparison participants may have experienced some decline in cardiac function with age. The rate of decline is similar in both groups even though the mean values for the astronauts are lower than the mean values for the comparison participants.

These are crude analyses that have not been adjusted for any other variables. Exercise, weight gain, other illnesses, life style activities, and use of medications to control hypertension all make an impact on cardiac function and might have been included as confounding variables. However, the intention of this examination was to look at the simple association of age and cardiac function. The results indicate that this association is an inverse one, and that the rate of decline may be similar for a range of initial blood pressure values. ■

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ing and intrusion detection technology) will be implemented to further strengthen and protect the integrity and confidentiality of all associated medical data.

Additional benefits from CMIS include:

Mission Support

- Required mission support data for Flight Surgeons would be tracked in a single source instead of multiple sources. Therefore, meeting the medical needs of the crew would be more efficient by having accurate and complete data available from one source and in an easily readable format.
- Mission data from preflight and postflight examinations, inflight monitoring, medical debriefs, and Flight Surgeon observations would be available from a centralized database.
- Medical requirements lists, medical checklists, toxicology databases, environmental databases, Flight Surgeon's references, and medical flight rules could be located in and facilitated from the CMIS.

Aerospace Medicine Board (AMB)

Information needed to provide reports to AMB for waivers and board decisions would be readily available.

Metrics Tracking Systems

Clinical quality controls could be implemented since information could be extracted from the CMIS to follow any aspect of care delivery. Prevention flagging would allow specific patient groups to receive care as designated by wellness protocols.

Trend Analyses

Disease states, safety, and occupational health issues could be monitored, *e.g.*, comparing the reported prevalence of flu during flu season *vs.* the number of patients taking the flu vaccine.

Epidemiology

Medical data systematically gathered and stored in the CMIS would facilitate research of inflight and ground-based medical events.

Implementation of the EMR will begin in the Flight Medicine Clinic followed by Occupational Medicine Clinic and will include relevant medical data from the LSAH. Clinic personnel will be working with Wyle CMIS Project Team members Martha Thomas, Phyllis McCulley, Byron Smith, and NASA Flight Surgeon and CMIS Lead Physician Patrick McGinnis, MD, to insure a smooth and successful transfer from a paper-based medical record to an EMR. Any questions or comments may be directed to the CMIS office at (281) 244-5177. ■

Black History Month Feature – The Tuskegee Airmen

After more than 50 years, the history of the Tuskegee Airmen is still fairly obscure. The name Tuskegee Airmen refers to the young Black pilots who received flight training at Tuskegee Army Air Field in Alabama during and shortly after World War II (WWII). Due to the rigid pattern of racial segregation that prevailed at that time, the Tuskegee Army Air Field was the only training facility for Basic and Advanced Flight Training for Black pilots of the U.S. Air Force (USAF). A total of 926 pilots earned their wings from the period of March 1942 to June 1946. Of these graduates, approximately 450 pilots went overseas to fly P-39, P-40, P-47 and P-51 fighter aircraft in combat.

Under the command of Colonel Benjamin O. Davis, these pilots fought in the aerial war over North Africa, Sicily and Europe. These gallant men flew 15,553 Sorties (flights of an aircraft on a combat mission) and completed 1,578 missions with the 12th Tactical and 15th USAF. The 15th U.S. Army Air Force's first Black general rose to the rank of Lt. General. During WWII, 66 pilots were killed in aerial combat while another 32 were either forced down or shot down and captured to become prisoners of war. These courageous airmen came home with 150 Distinguished Flying Crosses, Legions of Merit and The Red Star of Yugoslavia.

During the war the Tuskegee Airmen faced the contradiction between fighting for democracy overseas and being denied civil rights at home. These pilots made their advances during one of the most difficult times for Blacks in our nation's history. Many of the men remained in military service in the post-WWII era and spearheaded the integration of the armed forces in the United States with their integration into the USAF in 1949. Their hard work, common sense and devotion to America – and the idea that it stands for freedom for all – continue today. ■

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while a higher WHR reflects an "apple" distribution. Those who tend to put on weight above the waist – "apple" shaped people – may have a greater chance of developing high levels of "bad" cholesterol, hardening of the arteries, high blood pressure and diabetes. "Pear" shaped people carry their extra weight below the waistline, and do not seem to have as high a risk of developing the above conditions as "apples" do. A highly significant increase in risk for cardiovascular disease has been observed as BMI and WHR increase. This risk increase remains significant even after controlling for other health risk factors such as age, smoking status, educational attainment, physical activity and alcohol intake.

The presumed advantage of using measures of skeletal body build in risk assessment for cardiovascular disease is based on the underlying concept that these features can be measured early in life (*e.g.*, in early adulthood). This allows the identification of persons at higher risk of disease at a time when other risk factors, such as obesity, might not have developed. Life style habits which increase risk for morbidity and mortality, such as smoking and heavy drinking, also increase the WHR.

The safest way to reach your desirable weight is to modify your diet and exercise. Astronauts may obtain a fitness information and individualized exercise prescription by contacting one of the Astronaut Strength Conditioning and Rehabilitation Team members at (281) 483-7874. Other JSC employees may contact Larry Wier at (281) 483-0301 for more information on the Health Related Fitness Program. ■

Dietary Analysis Results

If you completed and returned a Food Frequency Questionnaire (FFQ) by December 3, your Nutrition Report is enclosed. If you have not done so but would still like to have your diet analyzed, send your completed FFQ form to the LSAH Office.

For your information

If you want a copy of your exam results, please complete and sign a release form while you are visiting the Clinic for your examination. The form is called *Privacy Act Disclosure Authorization and Accounting Record (DAAR)*, or NASA Form 1536.

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If you have a new address or phone number, please let us know by calling (281) 244-5195 or (281) 483-5785.

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