Susceptibility of healthy astronauts to orthostatic hypotension and a pressure sensation on human cardiovascular system is of critical importance to maintenance of astronaut health and safety. Hypotension, reduced plasma volume, is suspected to play an important role in cardiovascular deconditioning following exposure to spaceflight, which may lead to reduced peripheral resistance, altered arterial baroreflex, and changes in cardiovascular function. A promising countermeasure for post-flight orthostatic intolerance is fluid loading to restore lost plasma volume. Payment of fluid and water prior to re-entry. The main purpose of the proposed study is to define the temporal profile of cardiac responses to simulated 0-G conditions before and after a fluid loading countermeasure. Eight men and 8 women will be tested during 4 hour exposures at 0-G head down tilt (0-HDT). Each subject will be given two exposures to 0-HDT on separate days, one with and one without fluid loading (1 liter of 0.9% saline solution). Sedentary stress test will be done before and after each 0-HDT. Cardiac measures will be obtained with both impedance cardiography and echocardiography.

Buckey, et al. (1996) reported that up to 64% of astronauts experience post-flight orthostatic hypotension. Buckey, et al. (2001) found that 4 to 8 days flights result in 20% of astronauts experiencing hypotension, whereas the rate drops to 13% following a 12-19 day mission. Six-degree head-down tilt (HDT) can be shown to be an analogue to spaceflight, as it removes the gravity vector directed from the head to the feet and induces a similar cephalic fluid shift, as seen in spaceflight. (Forster Schneider and Greenleaf 1996; Charles and Bongu 1991). Currently, echocardiography is one of the most non-invasive methods for measuring cardiac responses to exposure to microgravity. Trans-thoracic impedance cardiography provides an alternative method for observing cardiac responses that can be measured continuously. The main advantage offered by this method is that the monitoring equipment is quick and relatively easy to set up. Portable, non-invasive and ubiquitous. Our primary goal is to know the time course of effects of fluid and salt loading on cardiac pre-load, so that we can advise the astronauts as to how long before re-entering the atmosphere is optimal for a fluid-loading point of view, which is the point in time, when 5% saline.

Researchers at NASA Ames have extensive experience in monitoring human physiology in extreme environments that include spaceflight, parabolic flight, chronic exposure to hypoglycemia in a centrifuge, and laboratory studies of orthostatic tolerance (Cowings, et al. 2007). In one study participants were exposed to 60° head-up tilt and other autonomic nervous system (ANS) function tests. The figure below shows a high correlation for stroke volume and cardiac output measured with echocardiography and impedance cardiography.

In a study conducted on the Zero-G aircraft cardiac responses were recorded from participants during 0-G parabolas. Simultaneous measures were obtained with echo ultrasound and impedance methods. Although echo measures were difficult to record during the micro-g phases of parabolic flight due to movement of the heart, there was a good correlation between echo and impedance measures as g-levels increased.