DEVELOPMENT OF A NASA/NSBRI RISK CALCULATOR TO ESTIMATE THE SHORT TERM RISK OF AN ACUTE CORONARY EVENT IN ASTRONAUTS: THE ASTRONAUT CARDIOVASCULAR HEALTH AND RISK MODIFICATION TOOL (ASTRO-CHARM)

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BACKGROUND: Recent changes in the scope and objectives of NASA missions require new approaches to address the risk of catastrophic medical events among astronauts, particularly cardiovascular (CV) events. Current CV risk assessment tools based on traditional risk factors including the Framingham Risk Score (FRS) have acceptable performance on a population level, but have insufficient accuracy on an individual level given the above considerations for NASA missions. Coronary artery calcium (CAC) scanning has emerged as the current best tool to enhance CV risk assessment in asymptomatic individuals, and the risk information is incremental to FRS data. Presently, there is no clinically available integrated calculator that incorporates CV risk factor and CAC information to provide the most accurate assessment of CV risk.

METHODS/RESULTS: In order to develop an integrated CV risk calculator that incorporates FRS variables and CAC scores, we combined participant level data from three population-based cohorts: the Dallas Heart Study (n=2752; ages 30-65), Multiethnic Study of Atherosclerosis (MESA) (n=6722; ages 45-84), and Prospective Army Coronary Calcium (PACC) study (n=2000, ages 40-50). Participants with baseline CVD or diabetes were excluded and the study cohort was restricted to participants ages 40-65. The primary outcome variable was non-fatal myocardial infarction, non-fatal stroke, and cardiovascular death. Cox proportional hazard models were created with traditional risk factors as the independent variables (age, sex, race, total cholesterol, HDL, systolic blood pressure, use of antihypertensive medications, smoking history, and glucose). Family history of myocardial infarction, C-reactive protein, and statin use were also tested to determine if they were independently associated with the outcome and improved model fit statistics. Log (CAC+1) was also included in the model and improvement in c-statistic and model fit was assessed. The Hosmer Lemeshow test was applied to determine model calibration and resampling techniques were applied to assess optimism of the model. The Beta coefficients from the model use to create a calculator to estimate the 10 year risk of CV events based on data input for risk factor and CAC values (demonstration provided).

CONCLUSION: The ASTRO-CHARM tool is the first integrated CV risk calculator to incorporate risk factor and coronary artery calcium data. It is a practical, easy to use, tool that will provide an accurate assessment of absolute risk of a cardiovascular event over a time frame relevant to an astronaut population, and in an age range generalizable to this group.