Astrocize: Anabolic Astronauts

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Abstract

Maintaining optimal health requires attention to both diet and exercise. We are proposing a comprehensive health plan to address the unique needs of astronauts in space. Maintaining muscle mass and bone density is a particularly salient consideration for space travelers. Muscle atrophy is caused by inadequate protein intake, reduced muscle use, and consistent caloric deficit. Studies have anticipated that bone loss can be mitigated with nutritional supplementation and regular exercise.

Astronauts will record their body metrics using Shapescale-like technology, which will send their information to a trainer on earth. The trainer will adjust their regimen to accommodate hypertrophy or atrophy. To combat muscular atrophy, astronauts will eat an amount of protein proportional to their body weight (.8 to 1g/lb) at a caloric surplus. Additional leucine - the most critical amino acid for maintaining muscle mass - is a diet staple, to be received from branched-chain amino acids (BCAAs) and whey [1]. Vitamins D3 and calcium will be supplemented for additional protection against bone loss.

Treadmill workouts are poor for maintaining or building muscle mass, so the Combined Operational Load Bearing External Resistance Treadmill (COLBERT) will be replaced with three resistance training techniques that incorporate compound movements for a full-body workout [2]. Kettle bell swings, pull-ups, and chest press will be simulated using elastic bands for resistance to build and maintain muscle mass and preserve bone density.

Keywords

astronaut, space, muscle, gym, atrophy, hypertrophy, protein, leucine, BCAA, resistance, elastic, bands, weight, train, training, nutrition

Introduction

When astronauts experience microgravity in space, their muscles and bones are subjected to rapid breakdown. Bone mass decreases in microgravity ten times faster than when afflicted by osteoporosis [3]. Crew members in the International Space Station follow protocol to work out for an average of two hours every day to prevent losing mass they had on earth. Typically they use instruments such as the advanced Resistive Exercise System (aRES) [4] or Combined Operational Load Bearing External Resistance Treadmill (COLBERT). However, these machines are not optimal for keeping the astronauts in peak physical condition. aRES is bulky and heavy in its initial transport, and treadmills not only take up a lot of space, but are poor for maintaining or building muscle mass when used for long-duration workouts [5]. A treadmill workout can burn hundreds of calories, which can place astronauts at a caloric deficit and impair anabolism. They also fail to engage many muscle groups, and so do not provide the best return on investment for time spent completing a workout. Nutrition also plays an important role in muscle and bone retention. In addition to reduced muscle use, muscle atrophy is caused by inadequate protein intake and consistent caloric deficit. A well designed workout regimen and diet plan can combat the physical challenges faced by prolonged exposure to microgravity.

Solution

Conditions of weightlessness introduce health risks for astronauts, including decreased muscle and bone retention. The goal of Anabolic Astronauts is to eliminate these risks with a diet and exercise plan that meets their unique needs. A proper diet must be engineered with the specific needs of the individual in mind. Shapescale-like technology [6] will be used to analyze the body composition of the individual and upload the information to an app, which will be synced with a trainer on Earth. The trainer will adjust the regiment in response to signs of hypertrophy or atrophy. Astronauts will all maintain a diet high in protein - especially leucine, the most critical amino acid for maintaining muscle mass. Leucine is easily available through branched-chain amino acids (BCAAs) and whey protein powder. With a caloric surplus, there will be plenty of nutrients available for absorption so that muscle mass is not compromised. In addition, vitamins D3 and calcium will be supplemented for protection against bone loss.

The present exercise equipment will be replaced by the lighter resistance bands, which offer more comprehensive training. With feet and resistance bands clamped to the floor, astronauts will simulate kettle bell swings which target hamstrings, glutes, hips, lats, abs, shoulders, pecs, and grip. Wearing a vest that connects resistance bands from the astronauts torso to the floor, astronauts will simulate pull-ups with a standard pull-up bar which targets back, lats, and biceps. Lastly, astronauts will lie on their back and be clamped to the floor, which allows the astronaut to push resistance bands upward to simulate a chest press which target the chest, front deltoids, and triceps. In our presentation we visually simulate these movements. Given a well-monitored tailored diet and exercise plan, astronauts will be able to prevent the catabolic effects of microgravity.

References

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