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METAGENOMIC EVALUATION OF THE MICROBIOLOGICAL BURDEN OF SKINSUIT THROUGHOUT AN ISS MISSION

Abstract

The microgravity environment induces physiological deconditioning due to the absence of gravity loading, resulting in bone mineral density loss of 1-2% per month, atrophy of lower limb skeletal and postural muscles, and lengthening of the spine up to 7 cm. Exercise reduces but does not alleviate these effects. The Gravity-Loading Countermeasure SkinSuit is a compression suit designed to replicate the gradual increase in Gz loading down the body, equivalent to that on Earth in a manner intended to provide greater resolution and comfort compared to existing garments, allowing crewmembers to exercise and sleep while wearing the suit in low gravity environments. We have evaluated fluctuations in the bacterial skin flora of an ESA astronaut during an eight-month pre-flight training period and as a consequence of SkinSuit wear during an eight-day mission aboard the ISS. Our initial ground-based studies indicated that short term wear resulted in no hygiene issues due to bacterial proliferation between the suit and skin. We determined if the interface between skin and suit provided a niche for microorganisms, including opportunistic colonisers such as Staphylococcus aureus, to proliferate and present a threat to wellbeing. The natural bacterial composition of skin (skin microbiota) from five discrete body sites of fifteen human volunteers was determined by DNA amplification and sequencing of 16S ribosomal RNA gene amplicons using the Illumina MiSeq System. These data provided a database with which to compare DNA samples from skin swabs from an ESA astronaut taken at regular intervals prior to launch and during and after the ISS mission. Pre-flight sampling was considered essential as significant reductions in the numbers of

beneficial bacterial components of the microbiota have been observed in astronauts preparing for flight and attributed to pre-launch stress. The astronaut's skin flora demonstrated dysbiosis during training, resulting in a shift to dominance by Staphylococcus species that was maintained during the ISS visit. On return to Earth the skin flora rapidly returned to a pre-training profile. Changes to the skin microbiota as a result of training were not exacerbated by SkinSuit use during the short ISS mission. The effect of long-term SkinSuit wear on astronaut skin flora should be investigated to ensure that niches on the skin do not become reservoirs for potentially pathogenic microorganisms.