Shocking Results on the Adverse Effects of CO_2 Exposures

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Carbon dioxide (CO_2) is released in large quantities from humans while they live and work in spacecraft or work outside the spacecraft during extravehicular activity (EVA). Removal of this anthropogenic pollutant requires major resources, and these resources increase dramatically as the levels of CO_2 set to protect human health and performance are reduced. The current Spacecraft Maximum Allowable Concentration of CO_2 aboard the ISS is 0.7% or 5.3 mmHg; however, according to Chits (mission action requests), NASA and its international partners have agreed to control CO_2 levels to less than 4 mmHg. In the meantime, retrospective investigations attempting to associate crew symptoms with elevated CO_2 levels over the life if the International Space Station (ISS) are underway to determine if this level is sufficient to protect against health and performance decrements. Anecdotal reports suggest that crewmembers are not able to perform complex tasks as readily in spaceflight as they were able during ground-based training. While physiological effects of CO_2 have been studied for many decades, it is only recently that the effects of CO_2 on higher reasoning capabilities have been studied. The initial results are shocking. For example, one study published in the respected journal *Environmental Health Perspectives* showed obvious adverse effects of CO_2 exposures on higher reasoning at 1.9 mmHg. The implications and limitations of this study are paramount in determining future CO_2 SMACs for human spaceflight, both aboard the ISS and in exploration-class missions.

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