**Introduction:** The Martian surface is a frigid, UV radiation-soaked, hyper-arid desert under a hypobaria atmosphere, an extremely hostile environment in which even Earth’s hardest organisms could not grow and reproduce. However, if life arose on Mars, its evolution would have been shaped by different environmental dynamics than those that life on Earth experienced. Therefore, the possibility exists that the evolutionary history of Martian life, if it ever existed, potentiated a capacity for it to adapt to the severe environmental changes that befell Mars, allowing life to exist near its surface today.

If life exists today in the Martian near-surface, i.e., within the first few centimeters of regolith, desiccation and UV radiation, particularly UV-C, would likely be the greatest challenges to its persistence there. The physiology and genetics of tolerance to these two stressors are well understood, but not their evolutionary dynamics. We therefore carried out an experiment in which replicate populations of *E. coli* were evolved under stress from desiccation and UV-C.

**Materials and methods:** Four groups of six clonal populations of *E. coli* were evolved for 500 generations under one of four conditions: desiccation only, UV-C only, both stressors combined, or no stress (control). The treatment groups experienced daily pulses of the respective stressor. Once the experiment was complete, fitness of the treatment groups under each stressor was assayed by competing the stress-evolved populations against the ancestor.

**Results:** We concluded that tolerance had evolved if mean fitness of the stress-evolved group significantly increased relative to the control group when exposed to the respective stressor. All groups evolved tolerance to their treatment stressor. Tolerance to the non-treatment stressor, i.e., co-tolerance (a.k.a., cross-tolerance), did not occur in any group; e.g., the desiccation-stressed group was not tolerant of UV-C. However, the group treated with desiccation and UV-C combined gained tolerance to both stressors. Increases in survival, rather than recovery, were the key to evolving tolerance in all three treatment groups.

**Discussion:** Tolerance to desiccation and UV-C evolved rapidly, within a mere 500 generations, in an organism that is very sensitive to these stressors (1.2% and 2.5% survival, respectively, for the ancestor). The tolerance levels of the evolved *E. coli* populations to these stressors is, of course, very far from those that would be needed to persist in the near-surface of Mars. Nevertheless, the results of our experiment demonstrate that tolerance to desiccation and UV-C can evolve quickly from an evolutionary history not potentiated by extreme environmental dynamics like those that would have shaped possible Martian life. Moreover, adapting to both stressors simultaneously does not appear to be overly difficult. However, our results also demonstrate that co-tolerance to these stressors, as seen in a number organisms, may not readily evolve; such an adaptive outcome would greatly benefit life in the multi-stressor Martian surface environment.

**Conclusion:** The Martian near-surface environment may be habitable under very limited circumstances. For example, if recurring slope lineae in equatorial regions on Mars are indeed the result of ephemeral briny water flows, then life adapted to desiccation and freeze–thaw cycles may be able to persist there. Concerning UV-C and hypobaricity, a few millimeters of regolith can attenuate UV-C, while Mars-level hypobaricity has been shown to be surmountable.