The impact of Mars atmospheric dust on human health

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Introduction: After prolonged exposure to Martian atmospheric dust, chemical pollution especially air pollution may occur in the space explorer habitat. Martian dust is regolith synonymous to talcum powder. Exposure route to pollution can be through inhaling, ingestion, dermal uptake. Prolonged exposure to Martian dust may result in central nervous system(CNS) related complications.

The martian dust impact can be considered as an exposure to ultra fine particles of martian dust.[1] Direct nose to brain pathway of particulate matter can affect the fine motor skills and gross motor skills, cognition may be affected.[2]

Entry routes to UFPs (Ultrafine particles) and nanoparticle particulate matter: Through this intranasal route, particles can reach CNS destinations 1) indirectly via blood capillary absorption (2) directly via olfactory and (3) trigeminal nerve fiber routes. The major impact may result in the magnetite settling in the brain cells. The trigeminal route enables the uptake of UFPs directly into the brain.(these routes are used for CNS drug administration *Quintana et al* [3]). Recently *Finch et al* [4] provided results of study on particulate air pollutants and their contributions to cognitive impairment in older women.

Consequences: Other major damages can cause the depletion of helpful gut microbiota of the human explorers of Mars. Imbalance and deterioration of gut microbiota may result in various complications, like decrease in tryptophan production, obesity, several neurodegenerative disorders leading to dementia and Alzeihmer's disease. Recent increasing evidence links air pollution to CNS diseases, behavior deficits, neuroinflammation, and neuropathology in human and animal studies [2a,5] Recently magnetite pollution nanoparticles in the human brain has been studied. [6]

In the first look at findings of NASA Twins Study [7] revealed an increased presence of tryptophan metabolite 3-indolepropionic acid(IPA) in the lipid panel of ground-based twin.[7] The indole moiety is found in human hormones such as serotonin and melatonin. Having a common precursor (tryptophan), the production of both serotonin and melatonin is affected by the availability of tryptophan. Melatonin produced by the pineal gland is known as our major regulator of the 'internal clock'. The gut microbiota help in the proper brain signaling.[8] Their depletion might result in decrease in tryptophan, resulting in serious consequences such as dementia, impaired movements, alzheimer's disease.[9]

Apart from role of human gut microbiota on human health such as obesity, diabetes mellitus, atherosclerosis, allergic, autoimmune diseases, it has also an impact on Central nervous system well being.[8] Brain function and communication is utmost priority for a human explorer on Mars, so the causes for any neurotoxicity should be explored.

Proposed research plans: By applying NIEHS Guidelines[2b], research on impact of Mars atmospheric dust on human can be done in the following way: Identifying 1) the neurotoxic components of martian dust 2) Study of cellular and biochemical pathway mechanism changes in the living systems. a) conducting in vivo studies and in vitro studies of impact of expected dust components. b) conducting blood brain barrier studies. 3) Finally assessment of the studies on human epidemiology especially related to CNS effects and neurological changes and gut microbiota.

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