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Investigating the Biological Impact of Sub-Natural Background Radiation: Insights from the REPAIR project

Natural background ionizing radiation is ubiquitous, yet its biological significance remains elusive. The REPAIR (Researching the Effects of the Presence and Absence of Ionizing Radiation) project investigates the consequences of sub-natural background radiation exposure, 2 km underground at SNOLAB. With experimental radiation dose rate reductions of between 7x and 550x compared to normal levels, we aim to understand the role of natural background radiation in maintaining normal function in biological systems. REPAIR has conducted three experiments to date. First, continuous cultivation of human hybrid CGL1 cells in a 30x reduced radiation environment at SNOLAB for 16 weeks compared to a surface control. We found increased alkaline phosphatase (ALP) activity in SNOLAB-cultured cells, suggesting elevated transformation rates. Second, desiccation and storage of yeast (S. cerevisiae) in a 7x reduced radiation environment at SNOLAB for up to 48 weeks. Reduced survival and metabolic activity in the sub-background environment indicate a negative response to the absence of background radiation. Third, further reduction in desiccated yeast background dose rate using lead shielding and a tailored yeast broth with a low concentration of the radioactive isotope 40K. This experiment achieved a 550x reduction in background dose rate, and its impact on yeast metabolic rates was significant. Our findings suggest that sub-background radiation exposure may increase neoplastic transformation rates in human cells and consistently affect yeast metabolism, underscoring the potential importance of natural background radiation in maintaining normal biological function. Further experiments are underway, probing deeper into the observed increase in neoplastic transformation resulting from sub-natural background radiation exposure.

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