A ground-based evaluation of the impact of neutron dose rate on health effects during space travel

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The lack of information on how biological systems respond to low-dose and low dose-rate radiation makes it difficult to accurately assess the corresponding health risks. This is of critical importance to space radiation, which remains a serious concern for long-term manned space exploration. Therefore, a growing number of particle accelerator facilities implement ground-based analogues to study the biological effects of simulated space radiation. In this presentation, we will introduce first results of a project on the "Optimization and validation of a unique ground-based *in vitro* model to study space health effects" (INVEST) at iThemba LABS, which aims to implement a first ground-based set-up to study space health effects in Africa. The focus of this work is on neutron irradiation, which is considered to be an important secondary component in space radiation fields. In a first set of experiments, the effect of neutron dose rate on immune system alterations and DNA double-strand break (DSB) induction and repair was investigated. Blood samples of adult volunteers were exposed to p(66)/Be(40) neutron irradiation (fluence-weighted average energy: 29.8 MeV) at a lower dose rate (LDR) of 0.015 Gy/min or a higher dose rate (HDR) of 0.400 Gy/min. DNA DSB formation was 40% higher at HDR exposure compared to LDR exposure. The DNA DSB levels decreased gradually to 1.65 ± 0.64 foci/cell (LDR) and 1.29 ± 0.45 (HDR) at 24 h post-irradiation, remaining significantly higher than background levels. The impact of neutron dose and dose rate on immune alterations was studied using the *in vitro* cytokine release assay. Recall antigens and mitogens were used to activate lymphocytes post-irradiation and dose rate effects on the cytokine production capacity of the cells were observed under specific conditions. The results give a first indication that the dose rate should be taken into account for health risk estimations related to neutron irradiation.

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