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Peer Review

# Review of: "Neurodegeneration: A Convergence Hypothesis Linking Chronic Low-Dose Diagnostic Radiation to Accelerated Decline"

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This manuscript presents a systems-level hypothesis proposing that cumulative low-dose head exposure to diagnostic ionizing radiation contributes to neurodegenerative risk by incrementally stressing three core maintenance systems: mitochondrial function, proteostasis, and neuroimmune regulation. The conceptual framing is internally coherent and aligns with established multi-hit and resilience-threshold models of neurodegeneration. However, the central causal extension implicating routine diagnostic radiation as a meaningful contributor to this convergence remains speculative and insufficiently supported by quantitative, epidemiological, or mechanistic evidence at clinically relevant exposure levels. The work is hypothesis-driven and clearly labeled as such. It is biologically plausible in parts but currently over-extended relative to available data. Specifically,

The manuscript advances a biologically plausible convergence framework but does not provide quantitative dose–response analysis linking real-world diagnostic radiation exposure to neurodegenerative risk. There are no lifetime cumulative cranial dose estimates, no comparison with natural background radiation, and no modeling demonstrating that dental radiographs, CBCT, or episodic head CTs approach levels known to impair mitochondrial, proteostatic, or neuroimmune function in human neural tissue.

The argument extrapolates from cellular stress responses observed in experimental systems to long-term disease risk without direct mechanistic evidence at clinically relevant dose ranges. Low-dose ionizing radiation can activate repair and antioxidant pathways, but it is not established that repeated diagnostic exposures cause progressive erosion rather than effective compensation or adaptive

 doi.org/10.32388/F8KHCo 

responses. The manuscript does not engage with low-dose radiobiology literature addressing dose-rate effects or hormetic models.

The hypothesis lacks epidemiological corroboration. If cumulative diagnostic head radiation materially increases dementia risk, detectable signals would be expected in large longitudinal cohorts of patients undergoing repeated CT imaging or in occupationally exposed groups. The absence of cited population-level associations weakens the claim of public health relevance and leaves the proposal at the level of theoretical plausibility rather than evidence-supported risk.

## Declarations

**Potential competing interests:** No potential competing interests to declare.