

A Comparative Time-Series Analysis and Deep Learning Projection of Innate Radon Gas Risk in Canadian and Swedish Residential Buildings

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Abstract : Accumulation of radioactive radon gas in indoor air poses a serious risk to human health by increasing the lifetime risk of lung cancer and is classified by IARC as a category one carcinogen. Radon exposure risks are a function of geologic, geographic, design, and human behavioural variables and can change over time. Using time series and deep machine learning modelling, we analyzed long-term radon test outcomes as a function of building metrics from 25,489 Canadian and 38,596 Swedish residential properties constructed between 1945 to 2020. While Canadian and Swedish properties built between 1970 and 1980 are comparable (96-103 Bq/m³), innate radon risks subsequently diverge, rising in Canada and falling in Sweden such that 21st Century Canadian houses show 467% greater average radon (131 Bq/m³) relative to Swedish equivalents (28 Bq/m³). These trends are consistent across housing types and regions within each country. The introduction of energy efficiency measures within Canadian and Swedish building codes coincided with opposing radon level trajectories in each nation. Deep machine learning modelling predicts that, without intervention, average Canadian residential radon levels will increase to 176 Bq/m³ by 2050, emphasizing the importance and urgency of future building code intervention to achieve systemic radon reduction in Canada.

Keywords : radon health risk, time-series, deep machine learning, lung cancer, Canada, Sweden

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