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**Abstract
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Human health risks of cerium contamination in urban and rural soils across Leicestershire (UK)

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BACKGROUND AND AIM:The aim was to determine the presence, distribution and risks to cerium (Ce) in topsoils from Leicestershire (UK).

METHOD:A total of 850 samples were collected (2017-18); 26 composite samples were appropriately prepared after mixing topsoil samples collected per park/location (18 urban, 8 rural), which were further processed in duplicate. Ce was measured in triplicate in each of the 52 composite samples by ICP-MS. Noncarcinogenic risks were characterised following US EPA methodologies.

RESULTS:Slightly higher levels of Ce were found in the rural area, although without significance (data presented as median and interquartile ranges, in mg/kg): 39.825 (29.156, 51.610) vs. 38.745 (35.012, 43.746), suggesting a wide dispersion of this element. The urban/rural regions were subdivided into the four ordinal directions to study the distribution of this element. A Duncan test showed significant differences in the presence of Ce throughout Leicester city ($p=0.037$; NE>SE>SW>NE), which might be attributed to the use of fertilisers, one of the major diffuse sources of rare earths in soils. The median level of Ce was lower than the described in soils (5-20 cm depth) sampled across London (50.9 mg/kg) and much lower than the described in topsoils monitored in urban parks in Beijing (82.7 mg/kg). Noncarcinogenic risks quotients for inhalation of Ce in resuspended soils (0.0248, 0.0255) were lower than the threshold for urban and rural areas, respectively.

CONCLUSIONS:Overall, Leicester's topsoils would be slightly less contaminated by Ce than other areas in Europe as they were lower than the described as background levels for European soils (39.2 vs. 48.2 mg/kg), and would represent a minimal risk through inhalation for the population living in Leicestershire. However, a better risk characterisation is needed due to the scarcity of toxicological data for Ce, including understanding the fate processes Ce undergoes in the environment to inform decontamination strategies.

Keywords: Exposure Assessment, Risk Assessment, Cerium