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# Environmental distribution and exposure to heavy-rare earth elements in Leicestershire (UK)

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**BACKGROUND AND AIM:**The aim was to determine the presence/distribution/risks to ytterbium (Yb) and lutetium (Lu), heavy-rare earths (HREEs), present 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. Both HREEs were measured in triplicate in each of the 52 composite samples by ICP-MS. Provisional sub-chronic oral reference dose for Lu was used to determine risks. **RESULTS:**Slightly higher levels of Yb [0.898 (0.492-1.142) vs. 0.828 (0.616-1.211)] and Lu [0.123 (0.069-0.162) vs. 0.117 (0.084-0.182)] were found in the topsoils collected in the rural areas (data presented as median and ranges, mg/kg), suggesting similar sources. However, Yb and Lu showed differences according to the urban subareas and followed a similar distribution; significantly higher medians of both elements in the NE (0.929, 0.134) and lower in the NW (0.720, 0.102), respectively ( $p$ -values=0.0209, all in mg/kg). Soil texture, specifically clay content, which can retain/absorb HREEs, might explain the distribution found in the urban subareas, as was significantly higher in topsoils sampled in the NE than in the NW (27 vs. 18.5%). The levels of Yb and Lu were lower than the reported background levels for UK soils by FOREGS (0.859 vs. 2.3; 0.121 vs. 0.3; mean averages in mg/kg), suggesting minimal anthropic contamination. Moreover, the levels of Yb in the urban area were much lower [0.859 vs. 1.9 (0.1-8.8; mean and range, in mg/kg)] than detected in London's topsoils. The noncarcinogenic risks quotients for ingestion ( $3.10E-06$ ,  $3.37E-06$ ) and dermal contact ( $1.10E-07$ ,  $1.20E-07$ ) in urban/rural areas for Lu, were lower than the threshold, respectively. **CONCLUSIONS:**In general, levels of Yb and Lu would represent a minimal risk for Leicestershire's population, although more toxicological knowledge for Yb is needed to quantify their risks.

**Keywords:** Ytterbium, lutetium, Leicester, topsoils, risks.