

## Abstract

# Environmental Exposure of Children to Silver in Alcalá de Henares (Spain): Risk Assessment Due to Its Presence in Topsoils <sup>†</sup>

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**Abstract:** Silver (Ag) is extensively used in a broad spectrum of personal care products and industrial products. Ag was analysed in scalp hair from 120 children (6 to 9 years old; 70 females) born/residing in Alcalá de Henares (Spain), and in randomly collected topsoils from different urban parks (n = 97) across Alcalá. Ag was detected in all samples (LoDs in hair and topsoils in µg/g: 0.0036, 0.049), except in three hair samples. Levels of Ag were significantly higher in females (median and range, in µg/g): 0.1199 (0.0168–0.4906) vs. 0.08916 (0.0139–0.3841), and slightly lower compared to those reported in hair from children (6–10 years-old) living in Madrid [0.1107 (0.0139–0.4906) vs. 0.251 (0.132–491); all in µg/g]. These authors also reported the deposition of Ag in hair was higher in females. The Spanish capital, Madrid, is more polluted than Alcalá, which could explain our results. Thus, the levels of Ag in Alcalá's topsoils [0.0680 (0.0492–4.0493)] were lower than those reported in other urban areas such as in Athens, Greece [0.260 (0.017–7.430); all in mg/kg]. Although the examination of the pollution index values (2.46; 0.65–53.55; data provided as mean and range) suggest some anthropogenic origin for the Ag found in the topsoils, the distribution of this contaminant was minimal and was only detected in 62 of the topsoil samples collected. Hazard quotients (HQs) for Ag were determined for ingestion and dermal contact; all values were lower than the safety thresholds for HQs (unity), suggesting a minimal risk for the population. Our results suggest that the monitored child population from Alcalá has a minimal exposure to Ag, as the geometric mean was lower than that reported in children living in Iglesias (0.095 vs. 0.13, 0–3 years-old) and much lower than that reported in children living in the polymetallic mining area in the Bolivian Altiplano (0.33, average 7.9 years-old; all in µg/g).

**Keywords:** silver; human hair; monitoring; Spanish teenagers; exposure



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