Environmental exposure of children to silver in Alcalá de Henares (Spain): risks assessment due to its presence in topsoils

Antonio Peña-Fernández[1*,2], *Manuel Higueras*[3], *María de los Ángeles Peña*[4], *María Carmen Lobo-Bedmar*[5]

[1] *Department of Surgery, Medical and Social Sciences, Faculty of Medicine and Health Sciences, University of Alcalá, Ctra. Madrid-Barcelona, Km. 33.600, 28871 Alcalá de Henares, Madrid, Spain.*

[2] *Leicester School of Allied Health Sciences, De Montfort University, Leicester, LE1 9BH, UK.*

[3] *Scientific Computation & Technological Innovation Center (SCoTIC), Universidad de La Rioja, Logroño, Spain.*

[4] *Departamento de Ciencias Biomédicas, Universidad de Alcalá, Crta. Madrid-Barcelona Km, 33.6, 28871 Alcalá de Henares, Madrid, Spain.*

[5] *Departamento de Investigación Agroambiental. IMIDRA. Finca el Encín, Crta. Madrid-Barcelona Km, 38.2, 28800 Alcalá de Henares, Madrid, Spain.*

**Correspondence: antonio.penafer@uah.es*

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 would be minimal, only detected in 62 of the topsoil samples collected. Hazard Quotients (HQ) for Ag were determined for ingestion and dermal contact; all values were lower than the safety thresholds for HQ (unity), suggesting a minimal risk for the population. Our results suggest that the monitored child population from Alcalá have 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.