On the Lead Content of Human Hair (1871–1971)

Weiss *et al.* (*1*) report that the lead content of human hair was much lower in 1971 than between 1871 and 1923, that is, before tetraethyl lead was introduced as a gasoline additive. They interpret this as demonstrating that overall intake of lead has decreased despite an increase in atmospheric lead levels.

The average lead concentration reported for the 1871–1923 samples of children's hair [164 parts per million (ppm)] is typical of levels found in contemporary cases of clinical lead poisoning (*2*), but is almost never observed in normal children (*2*, *3*). The mean level in the adult hair samples from the same period (93 ppm) is greater than the highest level found in a group of industrial workers with overt lead intoxication (*4*). Unless we are willing to believe that clinical lead poisoning was extremely prevalent between 50 and 100 years ago—indeed, almost ubiquitous—we must conclude that the lead content of these antique hair specimens is not a valid indicator of lead intake.

In their discussion of hair lead content, Weiss *et al.* do not distinguish between lead incorporated into the growing hair (endogenous) and lead subsequently acquired from external sources (exogenous). Of course, only endogenous lead can be related to lead intake. Comparing the total lead content (endogenous plus exogenous) in the antique and contemporary samples is not equivalent to comparing the levels of lead intake in the two populations: since there were different sources of lead in the two periods, the fraction of exogenous lead in the two groups of hair samples could also differ.

One important source of exogenous lead is bath water. Bate (*5*) has shown that hair has a strong tendency to adsorb heavy metal ions from aqueous solution, and that these ions are not removed by the rinse that Weiss *et al.* used (nonionic detergent). Compared to the present, the earlier population was exposed to more lead from water because of lead in plumbing and storage vessels. Therefore hair formerly acquired more exogenous lead from washing. [Schroeder and Nason (*6*) report a case of a man whose hair had a greenish tinge because of the high copper content of his bath water, but who had a normal level of copper in his urine.] Although the higher level of lead formerly present in water also raised the quantity of lead ingested, and consequently the endogenous hair lead content, some of the earlier sources of lead affected bath water only, and not drinking water: bathtubs, sinks, and basins once were made with a porcelain enamel containing a large proportion of lead in soluble form (*7*), much like ceramics with lead-based glaze that have not been properly fired.

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References and Notes

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We have no basic disagreement with Lockeretz's interpretation of our results. Our methodology and data do not allow partition of lead in antique hair samples into endogenous and exogenous fractions. Measurements of lead in blood or bone (or both) simultaneously with the hair lead measurements would be necessary. Unfortunately, blood lead levels in a population 50 to 100 years old are unavailable, and bone and hair samples from the same individual are difficult to obtain. Therefore, assessment of the percentage of total hair lead that is endogenous or exogenous is a matter of interpretation in our study.

Lockeretz argues that the exogenous fraction may have been considerably greater in the antique population and cites evidence to support this. While our report was in press, Renshaw *et al.* (*1*) reported that the lead concentration in a contemporary hair sample increased significantly from the root to the tip of the hair. They suggested that lead had entered the hair by deposition on its surface followed by diffusion into the hair structure.

The study by Renshaw *et al.* suggested an additional problem in the interpretation of our data, that is, whether the high lead levels in our antique samples could be due to contamination from air during their 50 to 100 years of storage. We had access to eight hair samples cut from young men in 1916 and stored together in an identical manner. These samples would have been subject to similar atmospheric lead contamination by deposition and diffusion. If, in fact, high levels of lead in our antique samples were due only to deposition and diffusion during storage, a similar increase within these samples should have been observed. The values in micrograms per gram (dry weight) for these eight samples were 82.4, 117.9, 37.4, 32.9, 210.4, 46.0, 200.3, and 164.8, which is not consistent with this interpretation.

We believe that there is also reasonable evidence that a significant fraction of the total lead in our antique samples was endogenous in origin, and have cited some of this evidence in our report (*2*, *3*). For example, Jaworowski (*3*) showed that there was a higher lead level in human bones from Poland from the 13th to the 19th century compared with contemporary bones from the same geographic location. Bone would probably not be subject to exogenous contamination and would reflect endogenous deposition.

It was a surprise to find lead contents in many of our antique samples that would be indicative of clinical lead poisoning if found in contemporary hair. The high lead content of the antique hair most likely represents both increased exogenous and endogenous deposition. Further studies correlating the lead content of hair with that of dated bones or deciduous teeth will be necessary to determine the relative contributions of these fractions.

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