A116 Considerations for Isotope Analysis of Human Hair: The Impact of Postmortem Environmental Exposure

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Learning Overview: After attending this presentation, attendees will appreciate the impact of outdoor exposure upon isotope ratios of human hair over time.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by addressing possible concerns for isotope ratios obtained from human hair exposed to outdoor environments and by encouraging discussion of the impacts of taphonomic processes upon isotope analysis of human remains.

Isotope analysis is a tool anthropologists have adopted from other disciplines, crossing into biochemistry, ecology, and geology to better understand the relationships between people and their environments. As forensic anthropologists use isotope analysis with growing frequency in order to provide additional information about unidentified human remains, it is necessary to assess the limitations of this analysis. While isotope analysis does not provide individual positive identification, predictions about diet and geographic travel prior to death can generate new information in the absence of other leads. Because hair grows at a predictable rate and provides information about the weeks and months prior to death, it has been used in forensic contexts and is particularly useful in determining whether an individual was local to a particular area or possibly traveled from elsewhere. Previous research and predictive geospatial modeling (i.e., isoscapes) were conducted using pristine hair samples from salons, which do not reflect the conditions typical of forensic recoveries. This study addresses how isotope ratios of human hair are impacted by outdoor exposure over time.

Two outdoor laboratories were used: the Anthropology Research Facility in Knoxville, TN, and the Forensic Anthropology Research Facility in San Marcos, TX. Body donors with known residence histories (n=46) were enrolled in the study. Hair samples that were collected prior to outdoor placement were compared to hair samples collected at various times throughout the decomposition process, with exposure times ranging from 22 days to 1,140 days (approximately 3 weeks to 3 years) postmortem. All samples were analyzed for carbon (δ^{13}C), nitrogen (δ^{15}N), hydrogen (δ^{2}H), and oxygen (δ^{18}O) isotope ratios, and a subset of 18 pairs were analyzed for strontium (^{87}Sr/^{86}Sr) isotope ratios. No statistically significant differences were observed between pre- and post-exposure samples for δ^{13}C (p=0.897) and δ^{18}O (p=0.267) values. Significant differences were observed in δ^{15}N (p=0.013), δ^{2}H ($p<0.001$), and ^{87}Sr/^{86}Sr ($p<0.001$), though it is important to consider meaningful interpretive differences versus statistically significant differences when comparing values. Additional statistical evaluation using linear growth models revealed that number of days of exposure, location of placement (TN or TX), and placement condition (surface or burial) are variables that impact isotope ratios of human hair.

While this study revealed that postmortem isotope ratios from human hair may be impacted by outdoor exposure, the observed differences did not significantly impact the dietary and geographic travel predictions made from the measured isotope values. With the ever-growing number of unidentified remains of migrants of unknown geographic origin, isotope analysis is an essential tool for the forensic anthropologist. Isotope analysis of hair continues to show promise for providing valuable information that can assist with the identification of unknown human remains, especially as understanding of the effects of taphonomic processes upon isotope ratios continues to grow.

Isotope Ratios of Human Hair, Isotope Analysis, Decomposition

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