A56 Identity by the Numbers: Cancerous Lesions and Likelihood Ratios

William D. Cawley, BA, University of Tennessee, 1611 Fremont Place, Knoxville, TN 37917; and Dawnie W. Steadman, PhD, University of Tennessee, Dept of Anthropology, 250 S Stadium Hall, Knoxville, TN 37996*

After attending this presentation, attendees will better understand how the frequency of skeletal cancerous lesions can contribute to a correct identification using a likelihood ratio framework drawn from Bayesian theory.

This presentation will impact the forensic science community by further demonstrating the utility of likelihood ratios when identifying an unknown individual. Additionally, the likelihood ratio generated in this study can be used multiplicatively with likelihood ratios derived from other parameters of the biological profile, thereby increasing the probability of a correct identification.[1]

The use of Bayesian theory has been gaining popularity within the forensic anthropology community for its ability to model the way in which decisions are made based upon varying levels of confidence. Through the evaluation of evidence in court, participants unknowingly utilize Bayesian reasoning when determining the weight of evidence while considering the legal proceedings and their personal biases.[1] As prior probabilities representing attitudes and effects of evidence on the jury's decision cannot be determined realistically, it is impossible to create posterior probabilities representing the weight of anthropological evidence. Therefore, this study instead focuses on the generation of a likelihood ratio representing the strength of macroscopic skeletal cancer when making an identification from a closed population of known antemortem records.

This project consists of skeletal analysis of a sample of adult individuals from the Bass Donated Skeletal Collection (BDSC) who self-reported as having cancer at the time of death or having had a previous cancer diagnosis (n=337). A preliminary randomized sample of these individuals (n=75) was initially analyzed for the presence/absence of macroscopic lesions and is the focus of this study. The BDSC was then used to represent the "population at large" (total n=1,432) from which the likelihood ratio numerator was drawn, this equation having been modeled using Steadman et al.'s likelihood ratio for skeletal pathology.[1]

Data collection involved physical examination of all skeletal elements for signs of primary bone cancer or secondary metastases. Of the 75 individuals in the preliminary sample, 16 exhibited macroscopic cancerous lesions (21.3%). Assuming this frequency remains constant to the subset of all individuals who reported having or having had cancer, 72 out of the 337 would be expected to show visible lesions in the skeleton. Thus, the expected likelihood ratio of visible cancerous lesions from the BDSC is 1,432/72, or 19.9. These results indicate that if a possible identification of an individual within a closed population matches the BDSC demographic, has a medical history indicative of cancer, and exhibits visible cancerous lesions, then it is 19.9 times more likely that they have been correctly identified than not. This preliminary likelihood ratio only represents a single category of pathology and is intended for combination via the product rule with other independent likelihood ratios representing additional parameters of the biological profile.

Although this study is limited by scope and composition of the BDSC (primarily middle-aged to elderly individuals), this presentation provides a further proof of concept for the generation of likelihood ratios representing pathological conditions and how they can be used to influence the quantitative probability of making a correct identification, even if DNA evidence is not available.

Reference(s):

1. Steadman D.W., Adams B.J., Konigsberg L.W. Statistical basis for positive identification in forensic anthropology. *Am J Phys Anthropol.* 2006;131(1): 15-26.

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