A124 Longitudinal Variation in Skeletal and Dental Development

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Learning Overview: The goals of this presentation are to present attendees with a longitudinal comparison of skeletal and dental development, followed by an exploration of preliminary patterns in health, and their potential health implications.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by contributing to the awareness that variations in development may be useful in improving the understanding of health histories of the deceased. Further, this presentation will shed light on importance sources of error in juvenile age estimation, including normal variation in the rate of development.

Skeletal and dental development are well known as being useful for the age estimation of juveniles. Complexities in age estimation arise when estimates derived from these two sources of data are dissimilar. Current research on the correlation between the systems has focused on cross-sectional correlations of sample means. In contrast, this presentation will explore the skeletal and dental growth patterns of individuals who were delayed, average, or advanced in their skeletal or dental development at the age of 3 years.

Longitudinal skeletal and dental development was estimated from the radiographs of 150 White (European American) girls who were part the Bolton-Brush Growth Study. Individuals had hand-wrist and lateral cranial radiographs taken at ages 3, 6, 9, and 12 years. Developmental age estimates were calculated using Greulich and Pyle for carpal development, and the London Atlas for dental development.[1,2] The sample was divided into two sets (dental or skeletal) of three subgroups (delayed, average, or advanced) based on development at age 3 years. Repeated measure Analysis of Variance (ANOVA) and Tukey's Honest Significant Difference analyses examined the longitudinal growth patterns of: (1) skeletal development of skeletal subgroups, (2) dental development of skeletal subgroups, (3) dental development between dental subgroups, and (4) skeletal development of dental subgroups.

Information on the girls' health data had been collected by Bolton-Brush researchers via a questionnaire to parents at each visit. The questionnaire included ten specific common childhood diseases, as well as colds and diarrhea. A cumulative count of total illnesses was made for each individual. Mixed linear models were applied to the four models to investigate the significance of disease on development.

The four models demonstrated significant differences between the three subgroups. For models 1 and 3, the pairwise comparison between the subgroups found significant differences between the developmental trajectories. This was not true for models 2 and 4. For model 2, delayed versus average and average versus advanced were significant, while for model 4, only the average versus advanced comparison was significant. This has important implications for the forensic estimation of age, because it suggests a complication in the relationship between the systems that has not been adequately explored.

Individuals who were delayed dentally or skeletally were consistently those who were the sickest between the ages of 1 and 5 years old. However, mixed linear models failed to find any significant effect of illnesses on skeletal or dental development when the three subgroups (delayed, average, or advanced) were compared. Additionally, based on the consistent pairwise significance of the average versus advanced comparison, mixed linear models were applied to only the average and advanced subgroups. Again, no significant effects of illness on development were observed for any of the four models.

These results reflect differences in development of the skeletal and dental systems between those who were at average development at 3 years of age versus those who were advanced at 3 years of age. Although these analyses failed to identify statistically significant effects of health, the case of childhood illnesses affecting the growth patterns of developmental variation is far from closed. Additional approaches to analysis might include primarily focusing on earlier illness events rather than health throughout childhood and approaching variation retrospectively from age 12 rather than predictively from age 3.

Reference(s):

1. Greulich and Pyle, *Radiographic Atlas of Skeletal Development of the Hand Wrist* (Stanford, California: Stanford University Press, 1959).
2. AlQahtani, Hector, and Liverside. Brief Communication: The London Atlas of Human Tooth Development and Eruption. *American Journal of Physical Anthropology* 142, no. 3 (July 2010):481-490.

Health, Age Estimation, Growth Patterns

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