

Comparing Diaphyseal Length to Dental Calcification Age of Subadults from Elmbank Cemetery

Sara Wilson^{1,2} and J. Christopher Dudar²

¹Department of Anthropology, Davidson College

²Department of Anthropology, National Museum of Natural History, Smithsonian Institution, Washington, DC



Smithsonian
National Museum of Natural History

INTRODUCTION

Long bone growth is more vulnerable to diet, disease, and lifestyle factors, making it a useful measure to examine the life history of a skeletal series. Dental calcification, which is under tighter genetic control, can function as the proxy for chronological age in order to detect deficiencies in long bone growth. The goal of this research is to better understand the growth of subadults buried at the historic Elmbank Cemetery. St. Thomas Cemetery was also included for comparison.

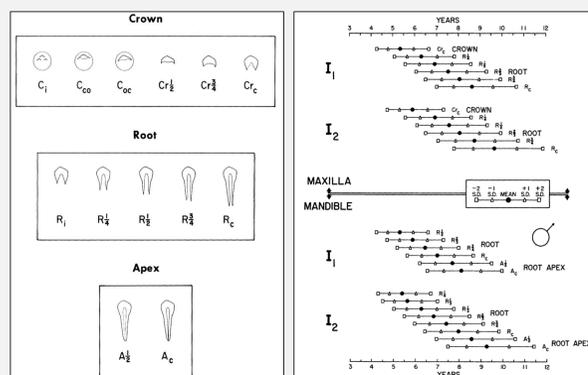
- Elmbank Cemetery (1833-1939) served a Catholic Irish immigrant community in Upper Canada. The area was largely agricultural with poor soil quality.
- St. Thomas Cemetery (1821-1874) was part of St. Thomas' Anglican Church in Belleville, Ontario.

METHODS

Dental calcification, diaphyseal length, and presence of pathological conditions were recorded for 154 subadults based on field notes from the relocation of Elmbank Cemetery off the grounds of the Pearson International Airport, Toronto, in 2000. The relocation was conducted by Archaeological Services Incorporated under the guidance of the Archdiocese of Toronto and approval of the available descendent families.

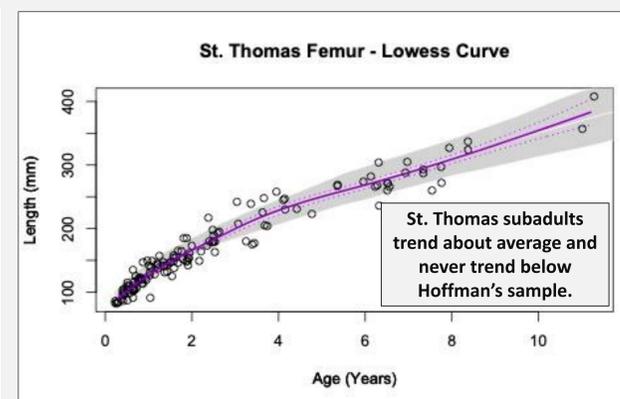
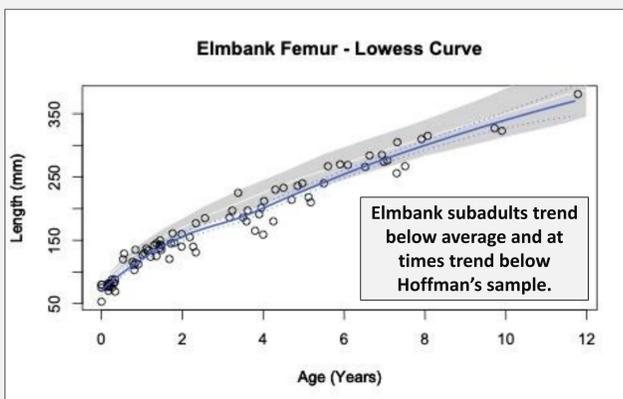
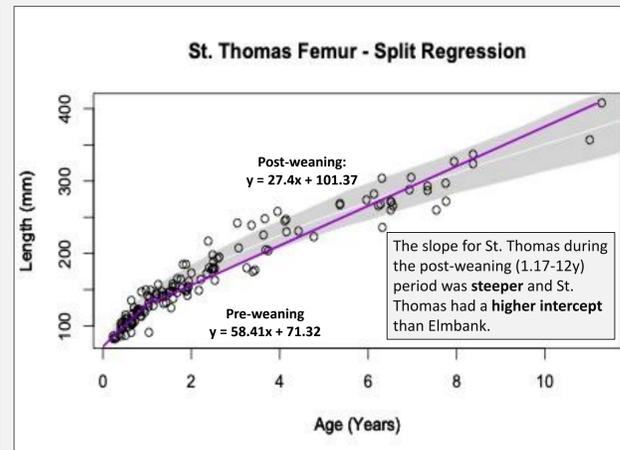
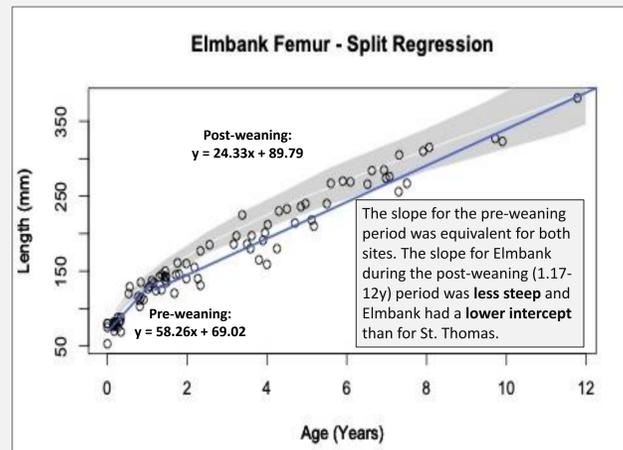
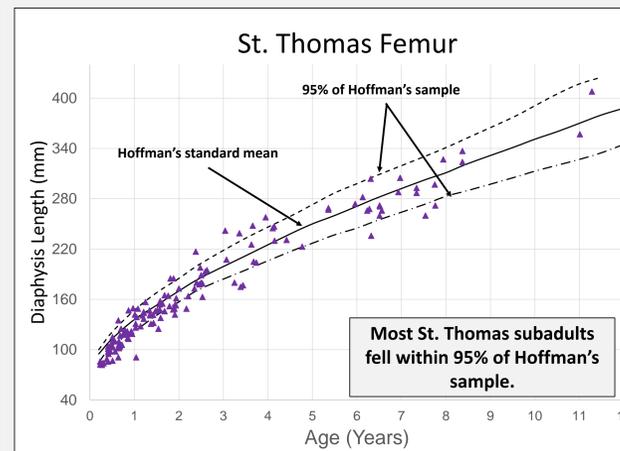
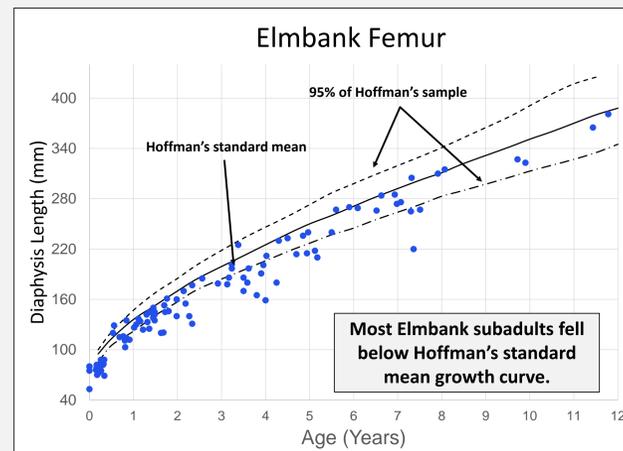
Dental calcification age was used as a proxy for chronological age. This was calculated by averaging the age estimations for each tooth according to standards formulated by Moorrees, Fanning, and Hunt (1969).¹ All long bones were studied and graphed, but for the purposes of this poster the femur was selected to represent the consistent trends across all long bones. Included on the graphs are Hoffman's three growth curves of expected diaphyseal lengths according to age: mean and ± 1.96 standard deviations.²

Split regression was employed to statistically compare the growth pattern of each bone at both Elmbank and St. Thomas. The regression analysis was split into before 1.17 years and after 1.17 years to reflect the breast-feeding period and post-weaning period.³ Lowess curves were also calculated with 95% confidence intervals to show trends using a method not limited to linearity.

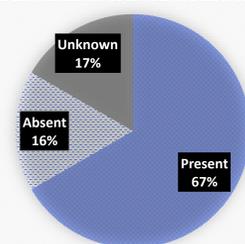


Moorrees, Fanning, and Hunt's dental calcification age standard chart.²

RESULTS

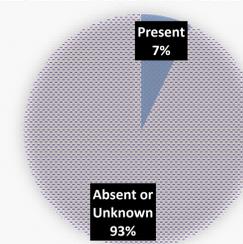


Prevalence of Stress Indicators at Elmbank Below Hoffman's Standard



Elmbank subadults displayed a far higher rate of paleopathological stress indicators than St. Thomas subadults.

Presence of Stress Indicators at St. Thomas Below Hoffman's Standard



DISCUSSION

Physiological stress such as disease or nutritional deficiency can delay growth. The likelihood that Elmbank children experienced chronic stress is further supported by the high rate of paleopathological stress indicators, such as enamel hypoplasia, cribra orbitalia, and porotic hyperostosis. However, it would be an oversimplification to conclude that Elmbank children had poorer health outcomes than St. Thomas children.

The Osteological Paradox requires a more nuanced interpretation of these results.⁴ All individuals in these skeletal series died prematurely, which is the ultimate outcome of poor health.⁵ Considering St. Thomas children largely reached expected growth, it is likely that they died from acute conditions, such as fast-acting diseases or injuries. Many Elmbank children from the skeletal series, however, survived periods of disease and/or nutritional stress that caused delayed growth. Analysis of covariance showed that the difference between Elmbank and St. Thomas during the post-weaning period (1.17-12) was statistically significant ($p < 0.001$).

The difference between Elmbank and St. Thomas for the pre-weaning period (0-1.17) was not statistically significant ($p = 0.27$). The similar growth and development status of newborn and toddler-aged individuals at St. Thomas and Elmbank may be due to the passive immunity and nutrition that breast milk provides.⁶ The concentration of individuals below Hoffman's curves between two and four years could be the result of weaning diarrhea,⁷ caused by the exposure to pathogens and a less nutritious diet. The slight dip in the Lowess curve for Elmbank children also reflects this period of stress.

ACKNOWLEDGEMENTS

Many thanks to all of those who made this project possible, including the National Science Foundation for funding, Virginia Power and Elizabeth Cottrell for crucial guidance throughout the NHRE experience, Gene Hunt for support in statistical analysis and guidance throughout NHRE, and Bonnie Kahlon for her assistance with St. Thomas data. A special thank you to the Archaeological Services Incorporated team at Elmbank, the Archdiocese of Toronto, the families who supported the cemetery relocation, and the individuals interred in the cemeteries, whose remains we respectfully study to illuminate their lives and experiences.



REU Site, OCE-1560088

REFERENCES

- Hoffman, J.M. "Age Estimations from Diaphyseal Lengths: Two Months to Twelve Years." *Journal of Forensic Sciences* 24, no. 2 (1979): 461-469.
- Moorrees, Coenraad F.A., Elizabeth A. Fanning, and Edward E. Hunt. "Age Variation of Formation States for Ten Permanent Teeth." *Journal of Dental Research* 42, (1963): 1490-1502.
- Herring, Ann D., S.R. Saunders, M.A. Katzenberg. "Investigating the Weaning Process in Past Populations." *American Journal of Physical Anthropology* 105, no. 4 (1998): 425-439.
- Wood, James W., et al. "The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples [and Comments and Reply]." *Current Anthropology* 33, no. 4 (1992): 343-370.
- DeWitte, Sharon N. and Christopher M. Stojanowski. "The Osteological Paradox 20 Years Later: Past Perspectives, Future Directions." *Journal of Archaeological Research* 23, (2015): 397-450.
- Katzenberg, Anne M., D. Ann Herring, and Shelley R. Saunders. "Weaning and Infant Mortality: Evaluating the Skeletal Evidence." *Yearbook of Physical Anthropology* 39, (1996): 177-199.