

Linear Enamel Hypoplasia in African Enslaved Individuals from Newton Plantation, Barbados

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The presence of Linear Enamel Hypoplasia (LEH) in dentition has been repeatedly linked to early life stressors, including malnourishment and effects of weaning. As such, LEH is commonly used in bioarchaeology to measure the effects of childhood stress in past populations. In this study, we examined dental samples from the Newton Plantation Burying Ground in Barbados (ca. 1660-1820) for LEH presence and age at disruption. LEH bilateral maxillary and mandibular first molars, canines, and central incisors were hand-scored by both authors, followed by inspection with a Dinolite W-20 digital microscope at 20x and a hand lens at 10x. LEH was measured using Mitutoyo digital needle-point calipers calibrated to .01mm from the defect's center to the CEJ. The total of 96 teeth from 17 individuals was scored. Antemortem tooth loss could not be assessed. LEH (n=6) was present in four individuals, two of whom displayed multiple defects. Based on Rose and Goodman (1991), LEH age at disruption ranged from 0.459 – 3.85 years. Malnutrition, environmental stressors, and other factors are well-documented archivally among the Barbadian enslaved, and these data suggest stress that started during early childhood. The presence of LEH only in individuals with isotopic signatures (Schroeder et al., 2009) of Barbadian birthplace supports the prediction of especially high stress for individuals born into enslavement. These findings contribute to more than 40 years of bioarchaeological research at Newton Plantation and provide new insights into early childhood stress.

Key Words: Newton Plantation Burying Ground, Barbados, Linear Enamel Hypoplasia, LEH, malnourishment, weaning, environmental stressors, bilateral, maxillary, mandibular, first molars, canines, central incisors, antemortem tooth loss, isotopic signatures, age at disruption, bioarchaeology.

Newton Plantation in Barbados, West Indies was established in the mid-17th century during an economic boom of commercial production of sugar. Sugar was highly sought after in the West Indies, particularly in Barbados where approximately 45,000 enslaved Africans were forced to the colony as laborers to support the production of sugar, rum, and other commodities. In the early 1970s, an unmarked slave cemetery was re-discovered on the grounds of the former Newton Plantation. Archaeological excavations by Jerome Handler et al. (1978) revealed a total of 104 skeletons. More than 40 years of bioarchaeological data have provided insight into the health and life experiences for the enslaved people who lived on Newton Plantation (Shuler et.al 2019), including evidence of non-specific stress in early childhood that resulted in dental growth arrest. Linear Enamel Hypoplasia (LEH) are defined as enamel defects that can appear as either grooves or pitting upon the labial enamel surface of the teeth; such defects have been linked to a variety of stressors, including malnutrition and infectious diseases that result in disruption of enamel formation during childhood (Franklin et.al 2022, 223). Previous studies from Newton reported modest rates of LEH (20% Corruccini et.al 1985; 19% Ritter 1991; and 17% Shuler 2005) based on clearly palpable enamel defects (Shuler et al. 2019, 273). Research in this study assesses the presence of LEH in a separate sample of individuals from the plantation and takes up other issues that have not been previously explored: the age at which individuals experienced the LEH stress episode, and whether LEH occur with greater frequency by birthplace (Barbados or Africa). Questions concerning early childhood stressors and how it may have impacted the enslaved people's health are addressed in this study. Frequency of LEH within the dental sample from Newton Plantation, calculation of age at disruption of LEH events, and comparisons of LEH events between Barbadian v. African born individuals can offer

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further bioarchaeological data for understanding the lives of past individuals on the Newton Plantation and enslaved early colonial Caribbean populations.

In this study, dentition from the 1997-1998 excavation sample were assessed for the presence or absence of LEH. We analyzed all available permanent, bilateral maxillary and mandibular central incisors, canines, and first molars. A total of 17 individuals in the sample could be scored for at least one of the aforementioned tooth types. Teeth were inspected under oblique lighting by both authors working together. Any identified LEH defect was further examined using a Dino-lite W-20 digital microscope at 20x and a separate 10x hand lens. Measurements were taken using Mitutoyo digital needle-point calipers calibrated to .01mm from the defect's center to the cemento-enamel junction (CEJ). Data were recorded in an Excel spreadsheet by burial number and tooth number. Antemortem tooth loss could not be recorded from this sample. The age at development for each enamel defect was calculated using regression formulae in Rose and Goodman (1991, 288-289).

Age at formation = age at crown completion – [(years of formation/crown height) x defect height (from CEJ)]

A total of 6 LEH were identified from 17 individuals in this study. LEH Burials 38 and 22 were the only individuals to have multiple defects. Burial 38 showed defects on both the upper right central incisor and the lower left first molar. Burial 22 showed defects on the upper left first molar. Burial 22 showed defects on the upper left canine and the lower right canine (Figure 1). LEH were found on all tooth types: a higher frequency was shown in canines (1/3). The frequency of individuals with LEH present was .04 of those who could be scored. LEH age at disruption for the individuals ranged from 0.459-3.85 years. For each tooth type, their age at disruption ranges were:

- First molars range = 0.4487-2.4359 years
- Central incisors = 0.8081 years
- Canines = 0.6250-2.8125 years

The results of the study also showed a higher rate of LEH presence in Barbadian born individuals than African born based on previously reported isotopic values for these individuals (Schroder et al., 2009: 553).



Fig. 1 Image displaying LEH on the lower right permanent canine of Bu 22 (photo by Katie E. Smith).

Table 1. Table depicting LEH present individuals / tooth number present / measure of LEH to cemento-enamel junction / age at disruption / place of origin for individual / strontium (*Schroeder et al. 2009) and lead levels (**Schroeder et al. 2013) for individuals in this sample.

Cat #	Age	Sex	⁸⁷ Sr/ ⁸⁶ Sr*	Pb (lg/g)**	Pb (conversion to blood level lg/dl)**	LEH
1	18-25	F	0.70916	12.4	124	RC ₁
22	18-23	M	0.70923	8.2	82	RC ₁ LC ₁
34	20-25	M	0.70915	27.7	277	RM1 ₁
38	18-23	M	0.70916	6.6	66	RC ₁ LM1 ₁

The stressors such as malnutrition, environmental toxins, weaning, and multiple other factors are well documented among the Barbadian enslaved, as previously supported through studies at the Newton Plantation (Shuler et al., 2019). LEH presence in individuals with multi-isotopic signatures of Barbadian birthplace supports former predictions of particularly high levels of early childhood stress for those who were born into enslavement, including exposure to toxins such as lead (Schroeder et al., 2013) and potentially to ethanol from rum (Shuler & Schroeder, 2013). In this study, the LEH data at Newton Plantation shows that enamel defects were impacting children as early as 0.4 years of age

and continued to impact them up to 3 years. Moreover, when combined with the published isotopic data, the LEH data from this small sample tentatively suggests that children who were born on the island may have been under a different type of stress than those who were later imported during adulthood. One factor in this may be exposure to an extremely toxic substance, lead, which has been documented in nearly all of the Barbadian born but absent from the African-born children at the site (Schroeder et al., 2013). Exposure has been linked to lead-tainted rum consumption, with toxins passed to children possibly in utero and/or during breastfeeding (Shuler & Schroeder, 2013). Regardless of the route, this likely would have contributed to high rates of physiological stress including, but not limited to, LEH and other indicators that have been reported from this site (Shuler et al., 2019). Such findings and former research upon the remains found at the plantation are accredited with over 40 years of former bioarchaeological research. This data study provides new advances towards dental studies and LEH analysis within Newton Plantation and other bioarchaeological sites/studies of the African Diaspora and trans-Atlantic slavery.

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Statement of Research Advisor

Katie did an excellent job with her project this year. She spent extensive time in the lab learning the intricate details of dental morphology, assisting with the collection of new data on enamel defects, and exploring recent scholarship in biological anthropology and bioarchaeology. Katie will expand upon this work over the next year by assessing a larger sample from the site and synthesizing the results with more than 40 years of published data from the Newton Plantation archaeological site. Katie's work is contributing valuable new data on early childhood stress experiences of enslaved individuals who lived on a 17th-18th century plantation in the Caribbean.

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Katie E. Smith is a senior-year student pursuing a B.S. degree in Anthropology at Auburn University. She is the assistant bioarchaeology lab director under Dr. Kristrina Shuler and the head student leader for CSI: Auburn. Her primary research focus has been studying dental morphology and linear enamel hypoplasia's upon a pre-colonial enslaved population from Barbados.



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