Early-Life Stress and Adult Mortality Patterns During Natufian Economic Intensification: The Linear Enamel Hypoplasia Evidence

Aaron Jonas Stutz, Fanny Bocquentin

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Early-Life Stress and Adult Mortality Patterns During Natufian Economic Intensification: *The Linear Enamel Hypoplasia Evidence*

by
Aaron Jonas Stutz[1,2]
&
Fanny Bocquentin[3]

INTRODUCTION

In the Fertile Crescent of Near East, Pleistocene mobile hunting and gathering gradually gave way to early Holocene agro-pastoral food-management systems. This study presents a new analysis of linear enamel hypoplasias (LEH) in the region's largest Final Pleistocene hunter-gatherer skeletal series, from the Natufian archaeological culture of the southern Levant (ca. 15,000-12,000 BP). We investigate whether adults experiencing osteologically recognizable early-life stress faced greater mortality risk in the context of economic intensification and reducing residential mobility.

SEDENTISM AND MORTUARY RITUAL IN THE FINAL PLEISTOCENE

The Natufian archaeological culture is notable for two hallmark features:

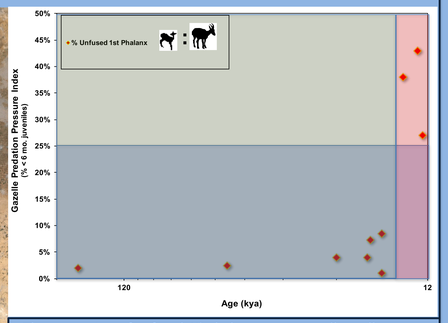
- *The settlement of multi-seasonal or year-round basecamps and hamlets with architecturally durable round structures*
- *The widespread practice of burial ritual in basecamps and mobile camp sites*

BACKGROUND: INTENSIFIED FORAGING

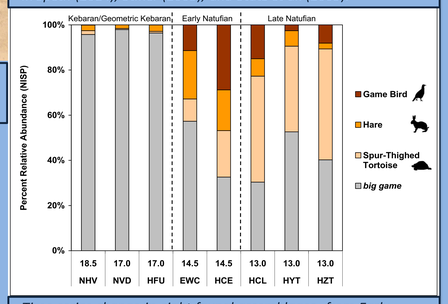
Early Natufian hamlet settlement involved economic intensification. Human hunting depressed big game populations, as fast-escaping small game were increasingly targeted (Munro 2004). Grain-processing intensification followed in the Late Natufian period (Dubreuil 2004).

Natufian sites with burials included in this study. Base map courtesy Google Earth (map data from SIO, NOAA, US Navy, NGA, GEBCO from Landsat Imagery)

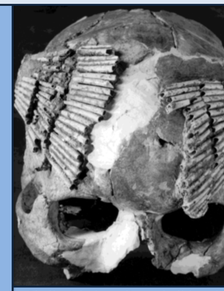
The Natufian—divided into Early (ca. 15-13 kya) and Late/Final (13-12 kya) periods—encompasses a critical transition to increased sedentism. For the first time, mortuary practices become widespread. Most Early and Middle Epipaleolithic (ca. 19-16 kya) sites lack burial features; only one known case contains more than two (Maher et al. 2011).



*The proportion of unfused 1st phalanges among all gazelle phalanges in a sample of Middle Paleolithic, Upper Paleolithic, and Epipaleolithic archaeofaunal assemblages in the southern Levant, ca. 200-12 kya. The mountain gazelle (*Gazella gazella*) first phalanx fuses around ca. 6 months of age, well before the juvenile has reached adult size. The index is calculated from data in Speth (2014), Stiner (2005), and Stutz et al. (2009).*

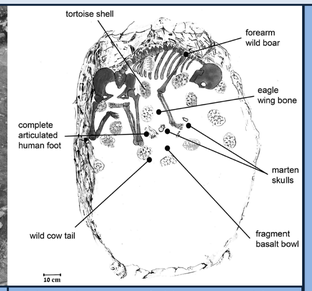


Time-series change in eight faunal assemblages, from Early-Middle Epipaleolithic (Kebaran/Geometric Kebaran) to Early Natufian and Late Natufian periods (ages shown in kya, site codes and data from Stutz et al. 2009). Shown are the rise and fluctuations in small game foraging.



Skull with dentalium shell head-dress, Early Natufian hamlet occupation of el-Wad Cave & Terrace, Israel.

Flexed subfloor primary burials in large round structure, Early Natufian hamlet occupation of Ain Mallaha, Israel.



Primary interment of older woman with diverse burial goods/food offerings, Late Natufian ritual cave, Hilazon Tachtit, Israel.

BACKGROUND: NATUFIAN BIOARCHAEOLOGY

The rapid increase in burial of the dead, from the earlier Epipaleolithic (ca. 19-16 kya), makes the Natufian archaeological sample the largest known Pleistocene-age skeletal series from a single regional archaeological culture. Linked to the rise of sedentism and foraging intensification, southern Levantine Natufian populations faced diverse biocultural changes.

Much previous work has focused on comparisons between Natufian hunter-gatherer skeletal samples and later Prepottery Neolithic agricultural ones. Populations from both periods were generally healthy (Eshed et al. 2004b, 2010; cf. Bocquentin 2003). Eshed et al. (2004a) suggest that adult mortality declined from the Natufian to Prepottery Neolithic periods. Alternatively, with the shift toward agriculture and village-based co-residence patterns, Prepottery Neolithic funerary recruitment may have become more biased toward interring male elders. In any case, the apparent decline in adult mortality is at odds with the data summarized by Bocquet-Appel (2008) and Guerrero et al. (2008). Relative juvenile mortality (5-19 years at death) may have risen in the Prepottery Neolithic period, possibly indicating higher population growth. We emphasize that Early and Late Natufian mobility, settlement, burial practices, and—very likely—health and demography varied substantially between sites and over the millennia. It is necessary to proceed cautiously in teasing apart signals of population biological change from those of cultural change in funerary recruitment.

AIM, MATERIALS, AND METHODS

In this study we carry out new analyses of data from the comprehensive database compiled by Bocquentin (2003), based on observations of 458 individuals from Early and Late Natufian burial features. Taking a conservative taphonomic approach, we address a new question in the bioarchaeology of populations under biocultural transition in Near Eastern prehistory:

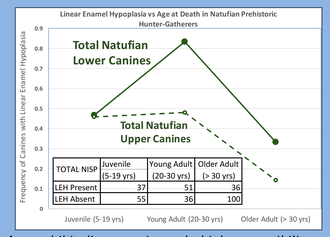
- ***Did early-life stress shape heterogeneity in adult mortality in the Natufian transition to sedentism and foraging intensification?***

We analyze LEH occurrences scored in 315 canines from 138 individuals interred in primary and secondary burial features across seven sites. The sample spans the Early (ca. 15,000-13,000 cal BP) and Late/Final Natufian (ca. 13,000-11,700 cal BP). Associated dental and skeletal data supported age-at-death estimates into juvenile, young adult (ca. < 30 yrs), and old adult (ca. > 30 years) categories (Bocquentin 2003).

RESULTS

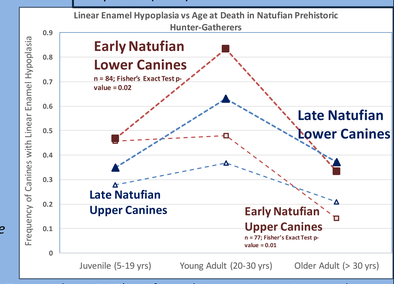
A conservative multiple-indicator approach to age and sex estimation (Bocquentin 2003) confirms the importance of analyzing taphonomically comparable categories. Thus, the decline in proportion of juveniles (5-19 yrs) from the Early to Late Natufian periods might be a taphonomic artifact of shifting mortuary practices, toward more common secondary burial in the Late/Final Natufian period. Studying LEH occurrence on the estimated-age individuals—interred in similar ways in the Early and Late Natufian periods—we can test whether early-life stress associated with higher adult mortality risk.

The LEH-age-assocation results consistently suggest that early-life stress significantly shaped mortality risk under Early Natufian foraging intensification and sedentary settlement. Developmental-stress effects on adult mortality appear to have ameliorated during the Late / Final Natufian period.

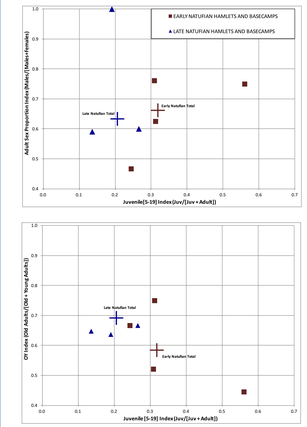


TOTAL NISP	Juvenile (5-19 yrs)	Young Adult (20-30 yrs)	Older Adult (> 30 yrs)
LEH Present	37	51	36
LEH Absent	55	36	100

*Natufian **canines** exhibit disproportionately high susceptibility to LEH, relative to incisors (Bocquentin 2003; cf. Goodman & Armelagos 1985). The total canine NISP sample (n = 315; Chi-Square p-value = 0.00001) shows a highly significant association between age at death and LEH formation.*



The canine MNI sample from all Natufian individuals (n = 87; Fisher's Exact Test p-value = 0.02) confirms this association. A general indicator of early-life stress, LEH is more prevalent in adults dying by 30 years. LEH is relatively rare in adults surviving past 30. Considered by period—Early versus Late/Final—it is only the Early Natufian sample for which the LEH-mortality association is significant.



Patterns in the figures above are belied by a significant increase in deposition of fragmentary skeletons—in secondary burials– during the Late/Final Natufian period. Later Natufian samples have more uncertain-aged and sexed adults (thus, not in the figures). For determinate versus indeterminate sex estimation, chi-square p-value = 0.01; for age estimation, p-value = 0.05. Sex and age estimation analysis described in Bocquentin (2003).

CONCLUSION

Young adult mortality is disproportionately associated with linear enamel hypoplasias, especially on the lower canines. The LEH-age-assocation results clarify some of the possible biocultural impacts and factors shaping the long-term emergence of agriculture:

- ***Did health improve in the overall Late/Final Natufian population? Or…***
- ***Were improved health and longevity restricted to higher status lineages/alliances?***

REFERENCES

[1] Division of History & Social Science, Oxford College of Emory University, astutz@emory.edu
[2] Department of Anthropology, Emory University
[3] UMR 7041 du CNRS, ArScAn, Equipe Ethnologie Préhistorique, fanny.bocquentin@cnrs.fr

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