Stature Change in Prehistoric Maya of the Southern Lowlands

Marie E. Danforth
University of Southern Mississippi, m.danforth@usm.edu

Follow this and additional works at: https://aquila.usm.edu/fac_pubs
Part of the Anthropology Commons

Recommended Citation
STATURE CHANGE IN PREHISTORIC MAYA OF THE SOUTHERN LOWLANDS

Marie Elaine Danforth

Since the 1950s, a decline in stature has been offered as evidence of increasing nutritional stress in prehistoric Maya populations, particularly during the Late Classic collapse. A review of the extant skeletal data, however, reveals very inconsistent support for such a decline. The primary explanation for the variation may reside in the small number of skeletal series that have representatives of more than one time period. Other possible explanations include methodological problems associated with stature reconstruction, reliability in sex determination, and variation in health response according to site size and location.

Desde los 1950s, una reducción de estatura ha sido presentada como evidencia de deficiencias nutricionales entre las poblaciones prehistóricas mayas, especialmente durante el colapso al fin del periodo Clásico tardío. Sin embargo, un repaso de los datos osteológicos no provee soporte consistente para tal reducción. Una explicación primaria para la variación en estatura puede ser que existen pocos series de esqueletos con individuos procedentes representantes de más de un período temporal. Otros posibles factores incluyen problemas metodológicos en la estimación de la estatura, un nivel bajo de reliabilidad en la determinación del sexo, y variación en salud según el tamaño de población y la ubicación de los sitios.

The analysis of stature has long been an integral part of health evaluation in both living and extinct populations because it serves as a general cumulative index of childhood nutritional and disease experiences (Falkner and Tanner 1986). Stature is affected by a variety of factors, among which genetics is one of the more important. As a result, height differences can serve as a basis for discrimination among gene pools and for detection of possible admixture (e.g., Saul 1982:117). Within a single gene pool, differences in stature among subgroups are most frequently attributed to differential access to nutritional resources, especially protein (e.g., Falkner and Tanner 1986; Haviland 1967; Huss-Ashmore et al. 1982). Indeed, many have argued that a reduction in stature is actually an adaptive plastic response in such circumstances because smaller bodies require less food (Stinson 1992).

It has been suggested that stature reduction began affecting Maya populations during the Preclassic (Nickens 1976; Stewart 1949, 1953). Stature reduction, however, has become most prominently associated with the Maya Late Classic collapse, as a result of the skeletal analysis of three populations. First, it was observed at Barton Ramie that decrease in long-bone diameters during the Late Classic suggested that the inhabitants were becoming less rugged and more gracile. Although Willey and colleagues (1965) felt that too few individuals were sufficiently preserved for reliable stature reconstruction, a stature decrease might be expected to have been part of an overall reduction in body size.

Second, Haviland (1967) published a well-known study based on the Tikal series in which he demonstrated a statistically significant reduction of 10 cm in height among the non-elite males from the Early to the Late Classic period, while stature among elite males remained relatively unchanged. Finally, Saul (1972) documented widespread anemia, infection, growth disruptions, and possibly scurvy among the prehistoric inhabitants of Altar de Sacrificios. He also concluded that stature had decreased over time at the site. Taken together, these three investigations soon led to conclusions...
Table 1. Intertemporal Comparisons of Mean Stature at Southern Lowland Sites and Zaculeu Based on Maximum Femur and Tibia Lengths.

<table>
<thead>
<tr>
<th></th>
<th>Preclassic</th>
<th>Early Classic</th>
<th>Late Classic</th>
<th>Postclassic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altar de Sacrificios*</td>
<td>167.1 (4)</td>
<td>159.8 (4)</td>
<td>162.3 (2)</td>
<td>159.5 (1)</td>
</tr>
<tr>
<td>Tikal*</td>
<td>164.5 (6)</td>
<td>167.0 (9)</td>
<td>157.4 (21)</td>
<td>—</td>
</tr>
<tr>
<td>Seibal*</td>
<td>153.1 (2)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Barton Ramie</td>
<td>154.3 (2)</td>
<td>154.0 (3)</td>
<td>156.6 (10)</td>
<td>—</td>
</tr>
<tr>
<td>Copan*</td>
<td>—</td>
<td>162.1 (1)</td>
<td>158.0 (11)</td>
<td>—</td>
</tr>
<tr>
<td>Tonina*</td>
<td>—</td>
<td>—</td>
<td>158.3 (4)</td>
<td>166.0 (1)</td>
</tr>
<tr>
<td>Zaculeu*</td>
<td>—</td>
<td>160.1 (5)</td>
<td>159.9 (6)</td>
<td>160.4 (20)</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altar de Sacrificios*</td>
<td>149.5 (2)</td>
<td>149.5 (2)</td>
<td>153.9 (2)</td>
<td>147.9 (1)</td>
</tr>
<tr>
<td>Tikal*</td>
<td>146.8 (4)</td>
<td>142.3 (3)</td>
<td>149.0 (11)</td>
<td>149.0 (1)</td>
</tr>
<tr>
<td>Seibal*</td>
<td>146.6 (3)</td>
<td>—</td>
<td>143.1 (2)</td>
<td>—</td>
</tr>
<tr>
<td>Barton Ramie</td>
<td>148.9 (2)</td>
<td>—</td>
<td>145.7 (6)</td>
<td>—</td>
</tr>
<tr>
<td>Zaculeu*</td>
<td>—</td>
<td>145.7 (2)</td>
<td>142.6 (1)</td>
<td>148.5 (4)</td>
</tr>
</tbody>
</table>

Notes: Measurements are in centimeters and sample sizes are given in parentheses. Figures paired in boldface, italic, and underlined text represent comparisons that are significant at $p < .05$ using the Mann-Whitney test.

* Saul 1972:108; only those individuals who could be reliably assigned to a single time period were used with Genovés’s (1967) formulae.

† Haviland 1967; for males, stature estimations were interpolated from Table 3, which used Trotter-Gleser (1958) Mexican male formulae; for females, stature estimations were interpolated from Table 5, which used Haviland’s modification of Trotter-Gleser white female formulae.

c Cohen et al. 1994 and Armstrong (personal communication); Genovés’s formulae were used.

d Romano Pacheco 1979; Pearson’s (1899) formulae were used.

e Stewart 1953; results are from my calculations using Stewart’s raw data with Genovés’s formulae.

that health was a major factor among the causes of the Late Classic collapse (e.g., Lowe 1985; Santley et al. 1986; Willey and Shimkin 1973). Furthermore, the decrease in stature has often been generalized to all prehistoric populations of the southern Maya Lowlands (e.g., McElroy and Townsend 1989:14; Saul and Saul 1991:300).

Several factors must be addressed, however, before such sweeping statements concerning prehistoric Maya health are made. For instance, and most important, the samples involved in most skeletal studies are very limited, both in numbers of sites and in numbers of individuals at each site. Also, certain methodological aspects of stature estimation, such as the choice of bones used in regression formulae and the determination of sex on the basis of long-bone size, can affect the reliability of stature estimation, especially with the small sample sizes available. Finally, even if stature reduction may be demonstrated at a few sites, the assumption that such a pattern was regionwide must be carefully examined in light of the variation in cultural and ecological factors in the southern Maya Lowlands.

**RECONSTRUCTION OF MAYA STATURE**

One of the consistent laments of those attempting to reconstruct health patterns among the prehistoric Maya is the condition of most human remains recovered. The acidic soil of the Peten, which is a poor medium for preservation, together with the occasional reluctance of archaeologists to excavate burials, has made small sample sizes the most challenging problem for those studying Maya collections. Only 12 of more than 50 sites with human remains from the southern Lowlands considered for this study yielded stature data not based on in situ measurements of the entire skeleton. Comparatively large skeletal series have been recovered at some sites, but most predominately date to a single period, such as the Preclassic remains at Cuello (Saul and Saul 1991) or the Colonial remains from Tipu (Cohen et al. 1993). Only six sites, listed in Table 1, offer the opportunity
for intertemporal comparison in stature reconstruction. As may be seen, however, the burials rarely are evenly distributed among the periods represented. The numbers are further reduced when the samples are subdivided on the basis of age, sex, and possibly social status. In the end, few periods are represented by enough individuals to allow statistical testing to demonstrate that stature differences do not simply reflect stochastic variation.

Even when adequate sample sizes exist, methods of stature estimation must also be carefully considered. The regression formulae most commonly applied today in Maya stature reconstruction were developed by Genovés (1967), but other formulae (e.g., Trotter and Gleser 1958) are occasionally used, owing partly to the fact that Genovés's equations have been widely published only for femur and tibia measurements. To ensure greatest comparability, the same bone or bones should be used for estimating stature. Estimations for the same individual can change markedly depending on the particular bones used. For example, if only the leg bones from the four Preclassic males at Altar de Sacrificios are used in the Trotter-Gleser Mexican formulae (1958), the mean estimated stature is 166.6 cm, whereas if only the arm bones from these same individuals are used, the mean drops to 163.8 cm (Saul 1972). In the Maya region, vagaries of preservation often result in great variety in the long bones available from various individuals in the same series. Furthermore, long-bone lengths are frequently estimated in order to increase sample sizes, and the missing portion of the bone may range from a styloid process to the distal third. All of these considerations simply mean that those who interpret temporal differences in Maya stature data need to make sure that there is comparability in the specific method of stature calculation used.

Poor bone preservation brings to light yet another methodological concern important in Maya stature reconstruction, namely sex determination. The most reliable sex indicators, which are found on the pelvis and skull, are frequently not well preserved. As a result, long-bone size itself often becomes a primary sexing criterion. The following experience at Barton Ramie is probably not atypical:

Sex determination was arrived at by means of comparative rugosity of the general bone features of the population . . . our initial cursory examination gave the impression that the skeletal material represented a predominance of women due to the light bone structure observed for the majority of the individuals in the sample. On more careful examination, one which took many factors of skeletal sex differences into account, the ratio of males to females turned out to be about fifty-fifty [Willey et al. 1965:536].

When long-bone robusticity alone is used to distinguish between males and females and the sexes are subsequently separated for stature reconstruction, a relatively circular pattern of analysis is established. In such circumstances, the range of variation will potentially be clipped by misclassification of short males and tall females. Even if sex determination is labeled as "probable" in poorly preserved individuals, often in subsequent analyses these individuals are treated similarly to those with more secure sex determination. At the other extreme, males and females at Barton Ramie were not even separated for bone robusticity evaluation (Willey et al. 1965). It can be argued, of course, that the possibility of misclassification exists in virtually every skeletal analysis, as do the effects of inconsistent methods of stature calculation. With the small sample sizes usually involved in Maya populations, however, the impact on the quality of the data is especially detrimental.

Even if the results listed in Table 1 are considered free of the above mentioned methodological considerations and hence accurate reflections of stature change, the pattern they suggest is not one of consistent stature reduction from Preclassic through modern times. In fact, stature of males at Seibal and Barton Ramie increased over this time range. Patterns of stature change at individual sites also vary by sex. Males at Altar de Sacrificios do appear to have been taller during the Preclassic than in later times, and males at Tikal show a statistically significant decrease in stature from the Early to the Late Classic. During the same periods at both sites, however, female stature increased. Although human biologists have argued that female body size will be less affected during times of stress because of greater genetic buffering (Stini 1969; Stinson 1985), it does not necessarily follow that women will increase in size as a result of stress.

One observation that the data in Table 1 do generally support is Stewart's (1949, 1953) suggestion that the modern Maya are shorter than their prehistoric ancestors. Mean male stature in most living
populations ranges between 153 and 157 cm; comparable values for females are 140 to 145 cm (Faulhaber 1970). The fact that most mean stature values from the various sites and time periods listed in Table 1 exceed these ranges leads to the not unexpected conclusion that some, if not all, of the stature reduction has taken place in historic times. Many possible explanations, from poor medical care to inadequate diet, exist for such a reduction, but their examination is beyond the scope of this paper.

Finally, we should question whether it is reasonable even to expect a regionwide stature reduction in the prehistoric southern Maya Lowlands. The observable variation in the stature data may accurately reflect the variation in health patterns of the inhabitants owing to differences in population size and nutrition. The sites listed in Table 1 represent wide diversity in population levels; population estimates for Tikal (Willey 1980) are many times those given for Barton Ramie (Ford and Fedick 1992). Consequently, health concerns would potentially have been quite different at the two sites. Small communities can be expected to have had fewer problems resulting from poor sanitation or airborne diseases (e.g., Storey 1985b). Their residents may also have had more opportunities to supplement their diet through hunting and foraging. In addition, microenvironmental differences in the Peten region would have resulted in marked variation in food resource availability. For example, Wright (1993) has demonstrated through isotope and trace-element analysis of human bones that inhabitants of various sites in the Pasión Valley differed greatly in level of consumption of maize and other dietary components. Thus broad generalizations, such as “the prehistoric Maya became shorter over time,” though appealing in their reductionism, blind us to some of the complex interplay of factors that influenced health patterns, and may have contributed to the Late Classic collapse.

CONCLUSIONS

Skeletal analysis clearly demonstrates that at different times some prehistoric Maya populations experienced relatively high levels of several health problems, including metabolic disruptions, anemia and infection (e.g., Cohen et al. 1993; Saul and Saul 1989, 1991; Storey 1985a, 1988; White 1986). Juvenile growth might be expected to have been adversely affected under such heavy disease loads, and Haviland (1967) does indeed demonstrate that non-elite males at Tikal experienced a statistically significant reduction in stature between the Early and the Late Classic period. A similar phenomenon may have taken place at other sites, perhaps throughout the entire southern Maya Lowlands, but the skeletal data have not thus far strongly supported such a conclusion. The pattern of stature change based on available data is, instead, one of great variability, which is most likely to be related to the extremely small sample sizes involved.

In summary, we need to document the decline in prehistoric Maya stature more fully, both in time and in space, before we use it as a major point of evidence in cultural reconstruction. On first suggesting the existence of the decline, Stewart (1953:300) noted, “Needless to say, too, more skeletal remains from ancient sites are needed for examination in order to establish beyond doubt the secular change in stature.” Perhaps 40 years later sufficient data exist to test his hypothesis concerning the inhabitants of Zaculeu, but the need for larger sample sizes to settle the stature question among the prehistoric Maya of the southern Lowlands still persists.

Acknowledgments. I would like to thank Carl Armstrong who collected the long-bone data for the Barton Ramie, Seibal, and Copan skeletal collections under the auspices of National Science Foundation grant BNS 85-06785 (Mark N. Cohen, principal investigator). I would also like to thank Delia Collins Cook, Keith Jacobi, and two anonymous reviewers for their helpful comments.

REFERENCES CITED

Falkner, F. T., and J. M. Tanner (editors)  

Faulhaber, J.  

Ford, A., and S. Fedick  

Genovés, S.  

Haviland, W. A.  

Huss-Ashmore, R., A. H. Goodman, and G. J. Armelagos  

Lowe, J. W. G.  

McElroy, A., and P. K. Townsend  

Nickens, P. R.  

Romano Pacheco, A.  

Santley, R. S., T. W. Killon, and M. T. Lycett  

Saul, F. P.  

Saul, F. P., and J. M. Saul  

Stewart, T. D.  

Stinson, S.  

Storey, R.  


Trotter, M., and G. C. Gleser  
White, C. D.

Willey, G. R.

Willey, G. R., W. R. Bullard, Jr., J. B. Glass, and J. C. Gifford

Willey, G. R., and D. B. Shimkin

Wright, L. E.

Received February 4, 1993; accepted October 12, 1993.